T, JULY 29, 1937. FIRST AERO WEEKLY IN THE WORLD REGD. AT THE G.P.O. AS A NEWSPAPER

AUG 9 1937

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH

Chief Photographer
JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
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Reporting of Accidents

FLIGHT has on more than one occasion criticised the long period which usually lapses before the official reports on fatal air accidents are issued. Sometimes the delay is unavoidable, as, for example, when there were no eye-witnesses or when the accident took place abroad and the aircraft was very badly damaged. There are, however, many occasions when such excuses cannot be made.

Another complaint which has reached us recently is the total absence of any official reports on accidents to privately owned aircraft. The explanation is, of course, that only when commercial aircraft are involved are official reports issued. When that system was introduced many of the really serious accidents were due to failure of the power plant or, more infrequently, due to some defect developing in the aircraft itself. It was probably felt that the manufacturer might suffer if the details of the reasons were revealed.

Nowadays a sudden engine failure is a very rare occurrence, and even more infrequent is the failure of any part of the aircraft. In fact, it may almost be said that the very reliability of aircraft and engines is the cause of accidents, inasmuch as flying is now carried out in weather conditions which would, a few years ago, have kept the machines on the ground. When, very infrequently, something does go wrong it is usually in connection with navigation in bad visibility. Errors of judgment, which may be a direct or indirect result of bad-weather flying, are responsible for a fair share.

The point is that there is no longer any good reason for refraining from giving full publicity to the causes of all fatal accidents to civil aircraft. It cannot be expected that R.A.F. accidents will be included; they are a matter for the Service, and there may be good reasons for not disclosing certain facts.

There is generally something to be learnt from every fatal accident, and in order that any lessons and conclusions may benefit others, it is very desirable that facts should be promptly and widely published.

A.A. Defence Under Fire

COINCIDENT with the annual camps of the anti-aircraft units of the Territorial Army, there has been published in the *Journal of the Royal Artillery* a strong criticism of Britain's anti-aircraft defences. The author is Captain G. K. Bourne, R.A., and the essay has won the Gold Medal of the Royal Artillery Institution, the award being made by three senior anti-aircraft officers.

Briefly, Captain Bourne's argument is that even the new equipment with which the A.A. units are now being provided is insufficient, the new 3.7 in. guns not having, he maintains, sufficient "ceiling" and inadequate provision having been made for defence against low-flying, fast-moving targets.

It is somewhat difficult to comment on Captain Bourne's essay, due chiefly to the fact that it is not permissible to disclose data relating to the newest types of guns and searchlights with which the A.A. units are gradually being equipped. From the fact that three senior anti-aircraft officers have thought fit to award the gold medal to Captain Bourne, one may, however, legitimately assume that these three officers share his views. If that is so, the situation gives cause for anxiety. *Flight* has repeatedly expressed its dissatisfaction with the present divided control of the A.A. units of the Territorial Army, and if the technical equipment is also open to criticism, the position is so much the worse.

Quick Aiming

Leaving aside the question of whether or not the new 3.7 in. A.A. guns have the "ceiling" that, with modern supercharged engines, will be necessary, the defence against low-flying aircraft will obviously call for some form of gun which can be swung very rapidly, and which has a high rate of fire. Captain Bourne is probably correct in claiming that the multi-barrel pom-pom is a better weapon for that kind of work. If so, watertight compartments in the Admiralty and War

Office are probably not so impenetrable that information cannot seep through, and the Minister for the Co-ordination of Defence might use his influence in seeing that the Navy's experience be communicated to the Army.

There is another side to this question of anti-aircraft defence which might with advantage come in for re-examination. For some considerable time it has been the custom, presumably in the interests of economy, to hire civil aircraft for co-operation with the A.A. units. On the face of it, this policy appears eminently sensible; a small civil aircraft obviously does not cost anything like so much in petrol and wear and tear as does a modern high-powered military aeroplane.

On closer examination it is, however, not difficult to see objections to this practice. The modern bomber is a high-performance aircraft, with a speed of anything from 200 to 250 m.p.h. A civil aircraft trundling along at a leisurely 150 m.p.h. or less does not give a very good imitation of the bomber, and neither searchlights, sound locators nor guns, get any realistic practice.

What is also a point to consider is that the R.A.F. itself misses an opportunity for much-needed practice. In times of war the fighter squadrons would have to work in the very closest co-operation with the A.A. units. At night, for instance, the fighters, no less than the gunners, depend upon the searchlights to show them the bombers, and it would seem to be but common sense for fighters of the R.A.F. to take part regularly and in considerable numbers in the A.A. training.

Our bomber squadrons, too, would benefit. Apart from the task of finding their way to a distant objective (and the number of accidents which have occurred recently seems to indicate that navigation is not the long suit of the R.A.F.), the crews of the bombers need to be thoroughly familiar with the sort of reception they would receive from an enemy when approaching targets in his country. Such experience can only be gained, in peace time, by practice with our own A.A. defences, and under the present system of hiring civil aircraft for the work the R.A.F. personnel is not getting that experience.

SOARING IN FAIRYLAND: A view which gives some idea of the wonderful scenery in which the recent Wasserkuppe gliding meeting was held.

Forthcoming Events

July 30-August 15. "Avia" Aero Exhibition, The Hague.
July 31. Cinque Ports Flying Club: Folkestone Aero Trophy Race.
July 31-August 2. Yorkshire Gliding Club: Opening Meeting, Sutton Bank.
August 1-14. Yorkshire Gliding Club: Instructional Camp, Sutton Bank.
August 3-September 7. Public Schools Aviation Camp, Norwich.
August 6-7. Austrian Aero Club: International Rally, Lake Worth.
August. 14. Eastbourne Flying Club: At Home.
August 14-22. Yorkshire Gliding Club: Open Contest, Sutton Bank.
August 20. L'Aero-Club de France: Marseilles—Damascus—Paris Race.
August 21. Thanet Aero Club: Aviation Meeting and Race.
August 21. Royal Artillery Flying Club: Meeting, High Post, Salisbury.
August 21. Midland Aero Club: At Home.
August 22-29. Italian Aero Club: Circuit of Littorio.
August 28 and 29. Cinque Ports Flying Club: Lympne International Rally and Wakefield Trophy Race.
August 28-September 25. B.G.A. National Soaring Competition, Great Hucklow.
September 4 and 5. Southend Flying Club: At Home.
September 10-11. R.Ae.C.: King's Cup Race.
September 12. Aero Club de France: Coupe Deutsche de la Meurthe, Etampes.
September 23. Aero Golfing Society: Cellon Trophy.

The Outlook

A Running Commentary on Air Topics

Public Relations

IF the right man can be found (or spared) for the job, there is much to be said for the suggestion made by Capt. A. G. Lamplugh in a letter to *The Times* last week that a liaison officer should be appointed to maintain direct personal contact with the different branches of the civil aviation community, listen to their difficulties and grievances and, after sorting the wheat from the chaff, submit essentials direct to the Director-General of Civil Aviation.

That it would not be easy to find the right man goes without saying. He would need to know both sides pretty thoroughly; he would have to be able to charm and sooth the savage beasts of the civil aviation community, and, if need be, he would have to be strong enough on occasion to tell them pretty bluntly "where they got off."

One obvious difficulty would be that of salary. The right man would be worth his weight in gold, and unless he was well paid the right man would not be forthcoming. In this connection one name inevitably comes to mind—that of Ivor McClure. Whether he would undertake the task is a horse of a very different colour. There are many who see in him the next D.G.C.A., and he might well be pardoned for refusing to be side-tracked into a job of this sort.

Some such "public relations" officer on the lines of those at the G.P.O. and B.B.C. is undoubtedly wanted. One imagines that the practical difficulties would be considerable, but they should not be insuperable.

U.S. to Go "Wet" Again

IT is not so long ago—in the pre-Kestrel days—that Mr. Fairey introduced into this country the Curtiss D-12 vee-twelve engine for installation in some of his high-performance military machines. At one time a complete R.A.F. squadron was equipped with these engines, but they were eventually replaced by our own Rolls-Royce F, or Kestrel, model.

In the U.S.A. a very large percentage of contemporary military machines were using the excellent Curtiss product, but as the D-12 became obsolescent there was a marked encroachment of radials into the American Services, the Navy even going so far as to declare that it would use air-cooled power plants exclusively. The Army specified the Conqueror prestone-cooled unit for a few of its aircraft, and even to-day fifty Consolidated fighters are in service with a special model of this engine incorporating an exhaust-driven supercharger.

Even so, there is a strong feeling in the U.S.A. that more energy should have been directed in recent years toward the development of the liquid-cooled engine. The "pro-liquid" spark has been fanned by the exemplary behaviour of the Rolls-Royce Kestrel and Merlin series in British Service aircraft, and American designers are bewailing the lack of truly up-to-date engines of similar calibre.

One new American unit—the Allison—has lately been type-tested and falls into the Merlin category, being a glycol-cooled model of about 1,000 h.p. It is being favoured not only on account of its small frontal area, but because it permits a practical installation of a turbo supercharger. A Curtiss fighter has been designed round the new engine.

It may be that, although the Americans realise the error of their ways in neglecting liquid cooling they will profit through their attention to the exhaust-driven blower which seems destined for big things.

The Pacific

FROM time to time *Flight* has called attention to the need for close co-operation between the British and American interests in the Pacific. Some months ago we pointed out that if Canada were to be linked with Australia and New Zealand certain *quid pro quo* concessions would have to be sought in order to permit British aircraft to use certain American bases on the Pacific coast and at Hawaii and elsewhere.

It is gratifying to see that *The Daily Telegraph* has now taken up the cause, thus lending its powerful support to a subject which, if a long view be not taken, may lead to disappointment in the future. The article by Tom Clarke in last Monday's *Daily Telegraph* explained how the present position has come about.

Attention is called to the "friendly dispute" concerning the ownership of Canton Island now going on between the British and U.S. Governments. Other islands come into the picture, and it has already become abundantly clear that the United States have shown more foresight than have we in realising the enormous importance which some of these small coral dots in the Pacific may assume.

Already America has surveyed and flown the entire route from California to New Zealand, and more than a year ago New Zealand granted a concession to Pan American Airways for entry into New Zealand. By now it may be taken for granted that New Zealand is alive to the position, and no irremediable harm has been done; the final say in these matters rests with governments.

No one admires the enterprise and foresight shown by Pan American Airways more than does *Flight*, and we could have wished that our own countrymen had been less slow in seeing the vast possibilities. But the issues at stake are such that Great Britain cannot afford to let America get away with it, and if necessary she will have to use any bargaining lever which comes to hand.

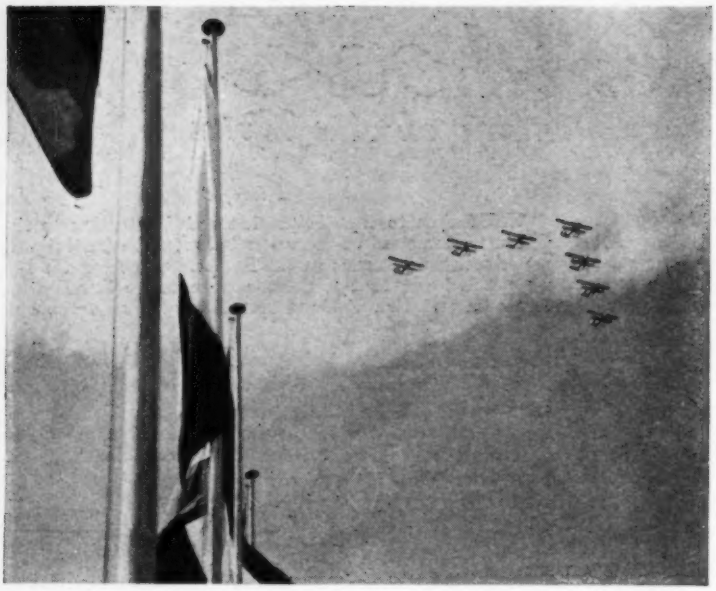
A Sister to Assist 'er

THAT the next important step towards larger payloads on long-distance air routes will take the form of some means for assisting heavily loaded aircraft into the air is now agreed by nearly everyone. What particular form the auxiliary equipment should take is, however, still uncertain. In the main, the choice seems to narrow down to two broad, general methods: the catapult and the Short-Mayo composite aircraft scheme. The former has the merit of having been thoroughly tried out with aircraft up to nearly 40,000 lb. gross weight. The latter has not yet reached the flying stage, although the first test flights of the two components of the Mayo are expected at any moment.

This week *Flight* concludes a review of what has been achieved so far in the field of assisted take-offs. It deals mainly with the subject of catapults, of which there are two main types: the true catapult in which the aircraft is carried on a launching carriage, and the "accelerator," in which a ram is also employed, but in which the aircraft runs along the ground on its own wheels.

Interesting schemes for track-launching are also mentioned, and it may well be that for the really large aeroplanes and flying boats of the future the equipment, including the permanent track and very powerful extraneous power supply, will be found to be the solution.

Without wishing to dogmatise on the subject, we feel that the future will show that there is room for both the catapult type (with its several variations) and the composite aircraft.



ZURICH

The First Three Days of the Big Meeting at Dübendorf : Formation Flying Extraordinary

(Illustrated with "Flight" photographs)

WE who see only our own display at Hendon are inclined, in our insular manner, to take it for granted that nobody else can do it all quite as well as we can. The depressingly few English pilots at the Zurich International Meeting must have suffered a minor shock. Ten Italian Fiat C.R. 32 fighters, led by Captains Remondino and Borzoni, and, perhaps even better, Lt. Fleurquin's Moranes of the Patrouille d'Etampes will give our four Fury pilots, led by Flt. Lt. E. M. Donaldson, something to live up to when they put on their show during the last two days of the meeting, which is continuing all this week. Admittedly, the French and Italian pilots have machines fitted with aerobatic fuel systems with the result that they think nothing of massed inversion at three hundred feet, but the crowd at Dubendorf Airport are not to know it.

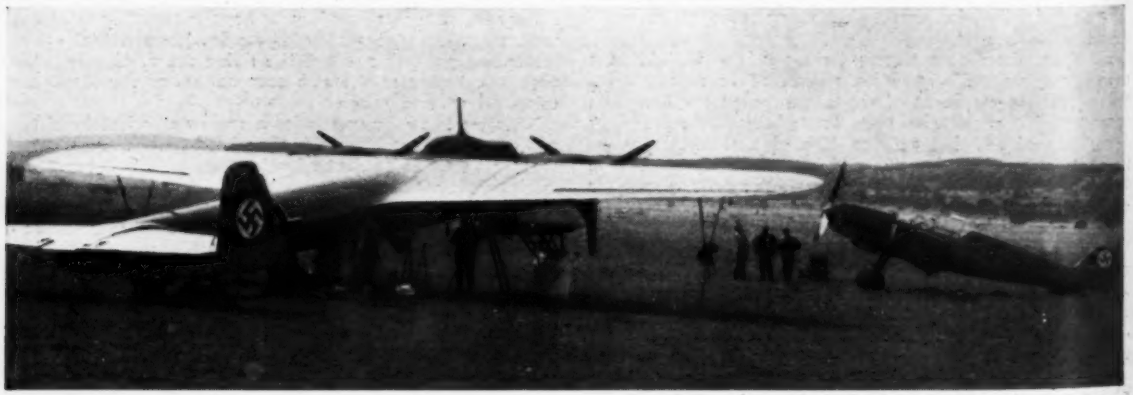
However, largely because the meeting has not been given official prominence in this country, Great Britain was represented only by one or two enthusiastic private owners, and by Mr. R. A. C. Brie, with an Autogiro, in the earlier stages of the event, and the Furies, with the Bristol Bombay transport which is taking out the pilots' equipment, will help to disperse the impression that we are sublimely indifferent to international affairs of this calibre.

For the Zurich show, which is held every five years, is undoubtedly the most important in Europe. More than a dozen countries are represented this year, yet only one of our manufacturers saw fit to send out a demonstration machine.

For the "arrival" competition we were represented by Mr. J. R. Micklethwait, the Yorkshire private owner, who came through from Heston in his Gipsy Moth and was placed ninth. Mr. Charles Gardner sportingly entered his Mew Gull in both the climb-and-dive competition and the speed race over a short circuit. Because his 200 h.p. machine was matched against military types of 800-odd h.p. he scratched for the first, but he flew in the race against two Messerschmitt 109 fighters of 950 and 640 h.p. respectively. He came in second after Udet, in one of the B.F.W.s had withdrawn.

The word "arrival" is quoted in this case because the competition was run on a formula basis in which power, number of passengers, distance, number of frontiers crossed and number of landings made were taken into consideration. The entrants had to leave for Zurich not earlier than 6 a.m., and arrive between 5 and 5.30 p.m. Unfortunately, the formula did not work too well. M. Louis Clement won with 1,453 marks, after a flight only from Buc (Paris). He was flying the tandem-winged Taupin machine with a 32 h.p. Mengin flat twin and his effort, in the circumstances, was stout enough, but hardly matched that of Major W. Polte, who flew a B.F.W. Taifun (Me.108) into fourth place with 867 marks. This pilot flew 1,490 miles from Belgrade, made eleven landings, crossed ten frontiers and carried three passengers.

It would be difficult to imagine a more perfect flying centre than Dübendorf, with its large, smooth area and Alpine background, and on the first day of the meeting (Saturday, July 24) the weather was almost perfect. The day opened with the preliminary heats of the aerobatic contest for machines with engines up to 10,000 c.c., and for ten minutes at a time we watched a succession of Bücker Jungmeisters being put through their paces. There *were* a few other machines, and



The Dornier Do. 17 bomber, known in Germany as the "Flying Pencil," and one of the new B.F.W. Me.109 fighters. Each won its class in the Alpine circuit at respective average speeds of 233.5 and 240.9 m.p.h.

INTERNATIONAL

the Jungmeister must be the world's best aerobatic device, but the pilots had to keep above 984ft. and their repertoire of fast and fully controlled flick rolls, outside half-loops and so forth was distressingly similar. The three finalists were: Oblts. Walo Hoerning and Hans Kuhn (Swiss) and Count Otto Hagenburg (Germany), in that order, and all flying Jungmeisters. Unfortunately, Hoerning's seat came adrift during the final, later in the day, and the ultimate order was reversed, Count Hagenburg obtaining 158 points. Hoerning is an Alpar pilot, while Kuhn is serving a radio operator's apprenticeship with Swissair.

The next event was the start of the formation flying contest with five Swiss-built Fokkers led by Hptm. Charles Schlegel, and a squadron of French Dewoitine fighters led by Capt. Raymond Destaillac. Their performances gave us something to think about.

Meanwhile, Mlle. Deutsch de la Meurthe had arrived in a Farman and the U.S. Air Attaché in Paris, Mr. Schunan, had arrived in a Caudron Simoun. The British Air Attachés from Paris and Berlin were already present.

Fast and Slow

As a contrasting spectacle it would have been difficult to have put two more suitable machines into the air together than the new B.F.W. (Me.) 109) and the Fieseler Stork. The former is one of Germany's last-word fighter monoplanes (comparable with the Hawker Hurricane) and flown by an unnamed B.F.W. test pilot, while the latter is a sort of super-H.P. Gugnunc—a 240 h.p. Argus-engined, three-place monoplane all covered with slots and flaps. It certainly did its stuff in the hands of Col. Udet—off the ground in twenty yards or less, 45-deg. slow-motion climb and autogiroptic landing. Its top speed is 130 m.p.h., and it might be worth operating a 240 h.p. motor for the sake of the genuine tennis-court landing and take-off. While the Fieseler sat about the sky, the B.F.W. thundered around at 300 m.p.h. or so.

Then came the Italian Fiat *staffel*—led by Capt. Remondino—and what a show! Ten machines flying together or in flights of five; formation loops, rolls and stalled turns; individual rolls and stalled turns; and, finally, a grand individual "shoot-up" from all directions. Here and there pilots lost position, but on the following day they were due to be well-nigh perfect.

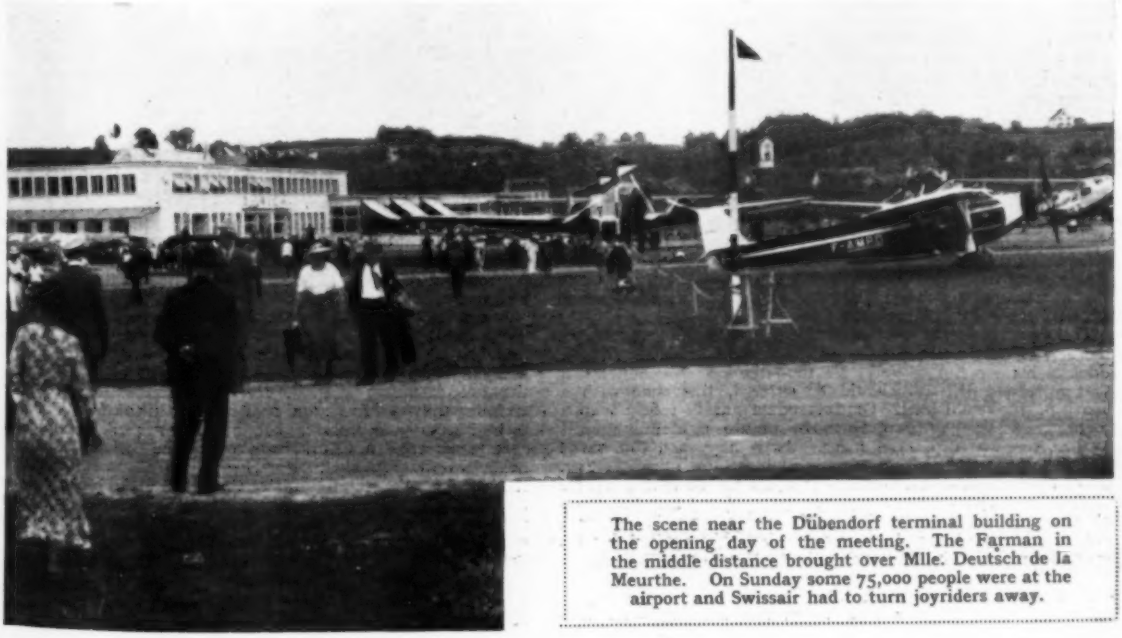
Keeping up the good work, Herr Achgelis forthwith took up his skywriting F.W. Stieglitz, filling the air with smoke while going through all known aerobatics, including a full outside loop at positively zero altitude. Our nerves were not to be given a rest. As soon as the Stieglitz had landed M. James Williams leapt from a Swissair Fokker, throwing away his parachutes in rapid succession and pausing for an unpleasant length of time before opening his sixth. We began to wonder whether he had miscounted and used them all up.

Casual inspection of the new Heinkel fighter, which made an unofficial appearance, suggests the use of a *canon* in addition to normal armament.

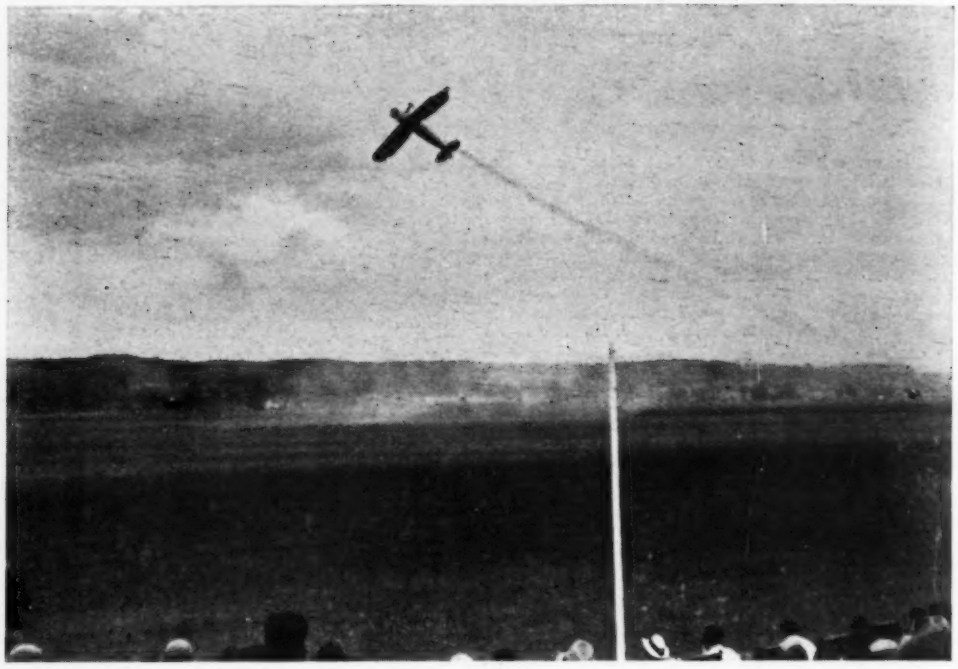
After three Czech Avias had given an aerobatic demonstration, Adj. Troyes demonstrated a French Autogiro, and finally Lt. Fleurquin led his six Moranes through the sky in all attitudes and at no altitude to speak of. They were out to show the Italians what they could do, and they certainly showed them. Timing and execution could not have been bettered, and the formation aerobatics, even when carried out at 200 ft., were smooth, safe and almost quiet.

Meanwhile a formation of sailplanes had been towed over the airport by three machines, one towing three sailplanes and the others towing two each. Allowing for the fact that up- and down-currents must have affected them all very much, the pilots, once loose, kept their formation very well indeed and landed almost together; only one pilot, who found himself too low to continue a circuit, had to break away, and even he landed more or less with the others. A very pretty exhibition.

On Sunday morning competitors and others were received by Dr. Motta, the Swiss President, who came to the airport for the afternoon meeting, which opened again with a flag-



The scene near the Dübendorf terminal building on the opening day of the meeting. The Farman in the middle distance brought over Mlle. Deutsch de la Meurthe. On Sunday some 75,000 people were at the airport and Swissair had to turn joyriders away.



Gerd Achgelis covers the aerodrome with smoke during his low-altitude aerobatic work in a Focke-Wulf Stieglitz.

flying formation by the Swiss Air Force, followed by Achgelis in the smoking Steiglitz—this time with wing-tip smoke to add to the gaiety.

Nine Fiats, led by Capt. Remondino, then did their excellent best in bumpy conditions for the first section in the formation flying competition. They covered most of the letters in the alphabet and wound up the show by flying in line abreast on alternate wingtips, forming a zig-zag when viewed from the front or rear. The Swiss Dewoitines, which followed them, repeated this quaint manœuvre and did it rather better. Led by Hptm. W. Eberschweiler their efforts were almost, if not quite, as good as those of the Italians.

The Czech Avias, flown respectively by Lts. Novak and Siroky and Adj. Vyborny, then fought out the individual aerobatics competition for machines with engines of 20-litre capacity. The result was in that order.

In the place of the demonstration of new types, two Autogiros, flown by Mr. R. A. C. Brie and Adj. Troyes were matched in the matter of slow flying and spot landing with the Fieseler. Honours were even, the extra hundred horse-power and the immense undercarriage movement of the super-Cugnunc giving the latter a certain useful advantage.

200 h.p. v. 950 h.p.

Lt. Fleurquin, the leader of the French demonstration team, then proceeded to show us all what he could do alone in a Morane. He was on his back before he had crossed the aerodrome boundary and the rest of his display can be imagined. Yet it was all smooth and safe enough so long as his Gnome-Rhone kept going in all attitudes.

The speed race was something of a flop. At the last minute, there being only two entrants—Gardner with his Mew, and Col. Udet in his 950 h.p. B.F.W. Me.109—the Germans had asked that a second B.F.W. should be entered, this time with a 640 h.p. Junkers Diesel. Gardner could hardly refuse such a request, so we had two up-to-the-minute fighters matched against one 200 h.p. civil racer. As it happened Col. Udet dropped out with throttle trouble and the last-minute entry, flown by Karl Francke, came in to win over a 125-mile course of four local circuits at an overage speed of 255 m.p.h.—probably well throttled back. Gardner's average was the excellent one of 220 m.p.h., and he was comfortingly praised for his sportsmanship in the columns of the local papers.

It would be dull to say that the Morane squadron's display was better than ever when it took the air for the second time, but the machines were rolled and stalled-turned *individually* in really tight formation, and did a squadron roll at about 400 ft. One cannot ask for more. The difference between the French and Italian shows was a matter largely of polish; the French pilots kept closer and held their formation rather better, but the Italian demonstration, which wound up the afternoon's meeting was definitely spectacular and impressive. Once again the courageous Williams let loose his various parachutes in turn, keeping careful count, and two pairs of sailplanes emulated the engine-driven craft by looping in formation and doing tight turns together.

The first week-end's popular shows were over and the less exciting events were staged for the week-days. Early on Monday morning two of the three Alpine circuit races were flown off over a course between Dübendorf, Thun, Bellinzona and Dübendorf—a matter of 230 miles over the worst of flying country. The first was won by Major Seidemann (Germany), flying a BFW 109 (DB 600 950 h.p. engine), in a time of 56 min. 47 sec. (240.9 m.p.h.), with Lt. Hlado (Czech.) and Adj. Snobl (Czech.) second and third, with Avia B.534s (650-750 h.p. Avia engines). The second section was won by Major Polte flying a Dornier Do.17 bomber (two DB 600 950 h.p. engines) with none other than General der Flieger Milch, who had come over for the meeting, on board. He covered the course in 58 min. 42 sec. (233.5 m.p.h.). Two Belgian pilots, flying Fairey Foxes, were second and third.

After lunch the first category of the International altitude competition was held. Entrants with multi-seater machines had to climb to 29,527 ft. as shown on a barograph, in the shortest possible time. The winner was Capt. Michy (France), who took a Mureaux 113 (860 Hispano) up in 20 min. 6 sec.

Later in the afternoon there were aerobatic displays and the climbing and diving competition with Foxes, Avias, Fokker C.35s and Dewoitines competing with the more modern Henschel 123 (a dive-bomber which is now obsolescent) and the ever-recurring B.F.W. Me.109. The latter's time for climbing up to 9,842 ft. and returning again to 984 ft. appeared to be phenomenally short, though the Henschel's climb looked spectacular enough. Karl Francke flew the B.F.W. and Otmar Schürfeld the Henschel. No wings came off and the noise as the pilots opened their throttles to "put on the brake" in the t.v. dive was usefully sky-splitting. Altogether a very impressive event which we had not seen before. As it turned out, rough timing proved correct and the results were: 1, Karl Francke (B.F.W. Me.109: D.B. 950 h.p. engine), 2 min. 6 sec.; 2, Otmar Schürfeld (Henschel 123: B.M.W. 800 h.p. engine), 2 min. 23 sec.; 3, Serg. Frantisck Perina (Avia B-534: Avia 750 h.p. engine), 2 min. 33 sec.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

ATLANTANKERY

IN view of the various methods mentioned with the object of giving the Atlantic service a pay-load it seems surprising that no one has suggested tanking up *Caledonia* in the air. [Actually, some of the possibilities are discussed in an article on pp. 124a-124d of this issue.—ED.] Such a method should allow an extra loading because of the absence of take-off troubles, and even if no extra load could be permitted, the fact that the machine would be a matter of fifty miles nearer its destination before the filling process was complete would mean an extra 400 lb. pay-load in place of the fifty gallons saved on the first fifty miles. A gift of 400 lb. should not be overlooked; in fact, it might be a paying proposition to use one of the old four-engined restaurants to canter out a couple of hundred miles before tanking-up the greyhound, and then about 1,500 lb. extra could be taken.

The process has even a third possibility: two *Caledonias* set out together, No. 1 having 11,000 lb. fuel and 8,000 lb. extra pay-load; No. 2, 19,000 lb. fuel. No. 2 boat saves 8,000 lb. fuel for No. 1, and, having 11,000 lb. for herself, has a range of 700 miles or so.

The cost of each trip would be thus increased by about 70 per cent., but the pay-load more like 200 per cent., and neither boat would ever be overloaded.

A D.H. Albatross could be helped in the same way as an Empire type with, probably, better figures, but the main idea of filling in the air is the same as the composite arrangement which aims at getting a heavy machine safely on its way, and it seems a less complicated system. TANKA.

Huddersfield.

MAN-POWER FLIGHT.

I HAVE read with interest the comments in "The Outlook" of July 15 on my article on the above subject. "The Outlook" writer suggests that I "suffer from an excess of optimism" in the power needed to change the sloping path of a glider into horizontal flight and he suggests that I have "come unstuck" on the power that man can develop. Then he proceeds to produce figures of man's h.p. *which are identical with the figures I gave !!*

It is true that he puts more on the legs and less on to the arms, but I can assure him that he is entirely wrong in both statements, as I have been carrying out accurately measured tests for more than twelve months and can demonstrate them at any time. [See footnote 1 below.—Ed.]

With regard to the weight of the complete machine "The Outlook" paragraph suggests that the total weight will be some 70lb. heavier than I have specified. I do not think we have reached the last word in weight reduction and I am already in a position to satisfy the writer that he is wrong.

"The Outlook" then proceeds with a most pessimistic view to prove that the h.p. required would be nearly 1½ *which is within the figure attainable that I specified and within the figure that the writer has confirmed!!* [See Note 2.—ED.]

"The Outlook" suggests that a machine such as I require would be large and fragile. Are not all aeroplanes large and fragile? I am, of course, aware of the "Katzmayr Effect" and of Mr. Townend's deductions, and whilst I have every respect for these theories, I do not believe that they will assist man-power flight.

I am convinced from the point of view of lifting capacity that the Wright Bros. were wrong in their original conception of the flying machine. I am satisfied that they had one thought only, and that was *to fly*, and that their ability to do this arose purely from the fact that they understood the basic principle, i.e., that the centre of lift must coincide with the centre of gravity and that any variation by varying air currents must be compensated by warping wings and elevator. They were not concerned with the most efficient method of aerial propulsion and they chose the bird's most inefficient feature, which is that of using its wings as glider planes.

I have studied bird flight for hundreds of hours and the more I study it the more I realise that evolution taking millions of years to produce its twentieth century model against ills like death from destruction has produced something that man would do well to study, not only from the point of view of flight but also from the point of view of a mechanical structure.

It is obvious that it is wrong to preface an article based upon entirely new aspects with reference to technical data based upon different aspects, especially if these different aspects are purely academical ones and working upon a different line of progress. In "The Outlook," for instance, you refer to the "apparent ease with which a bird can fly" and then suggest that I should take Mr. Townend's advice and build a machine "without using the large amplitude of oscillation used by a bird." This, of course, is self-contradictory and, in my opinion, my article should not have been prefaced by one that is lacking in imagination. If we had all lacked imagination there would be no flying machines to-day and I feel that I need only cite the two following statements to show how one can be led astray by academical considerations.

In "The Outlook" you suggest that "It seems to be largely a question of designing wings to have a natural period of oscillation which would suit the natural speed of 'rowing' (my suggestion) which the human power plant would adopt." Then you quote the final advice of Mr. Townend that "Even if the structural difficulties should appear great, it would seem to be worth while to know whether it is fundamentally possible to transfer the necessary power by the mechanism in question without using the large amplitudes of oscillation generally associated with the usual proposals of flapping flight." Now, it is obvious to any engineer that both these remarks are of the textbook order because it is perfectly simple to arrange any constant or varying speed of reciprocal and/or rotary-cum-oscillating action by means of the most elementary gearing, and in any case, what is wrong with "large amplitude"? Birds get on all right!

If "The Outlook" writer, who suggests that I "suffer from an excess of optimism," would like to indulge in a little education that might provide him with some degree of imagination perhaps he will study some of the fat and over-fed pigeons in Trafalgar Square, which, with wings half decayed with age, can rise vertically to the top of Nelson's Column, and he will realise that nature's method of flight, as the result of some millions of years with test, trial and error is many times more efficient than the most up-to-date aeroplane that man has yet devised.

London, W.1. GRANVILLE BRADSHAW.

(1) It is difficult to see how Mr. Bradshaw arrives at the conclusion that the figures quoted were identical with the figures he gave. In his article Mr. Bradshaw estimated that Oxford and Cambridge boat race crews "are each developing between 2½ and 3½ b.h.p. in a race of this description" (bottom of right-hand column, page 76c). Professor Hill stated that towing tests on a boat with crew aboard had indicated that the average power output per man was about ½ h.p. for 20 minutes.

(2) The "most pessimistic view" used to prove that it would require nearly 1½ h.p. to convert the sloping path of a glider into a horizontal flight path was based upon Mr. Bradshaw's own premises. He took a *glider* weighing 230 lb. all-up (middle of right-hand column, page 77) and assumed that it would have a gliding angle of 1 in 30 in still air, but he coupled with that assumption the further one that the speed would be 8 m.p.h. It is important to remember that Mr. Bradshaw himself introduced the glider as the basis for estimating the power required. He did not, in that particular connection, refer to other possible means of obtaining lift, but was dealing with the *glider*. Now there is, of course, nothing difficult in calculating what sort of wing area would be necessary to enable flight to be made at a speed as low as 8 m.p.h. The formula is our old friend $L = k_L \rho A V^2$. From this it is found that if we assume for k_L corresponding to maximum L/D a value of 0.7, in the old-fashioned British "absolute" units, the wing area necessary to make it possible to fly at 8 m.p.h. would be 1,000 sq. ft. for a *glider* weighing 230 lb.! At 8 m.p.h. induced drag would be extremely important, and an aspect ratio of about 20 would probably be necessary if one were to have any hope of achieving a gliding angle of 1 in 30. Such an aspect ratio would necessitate a wing span of 142 ft. with a chord of slightly more than 7 ft. There was therefore some justification for advancing the view that it would not be possible to build a glider with a gliding angle of 1 in 30 for a loaded weight of 230 lb.

(3) Mr. Bradshaw has slightly misunderstood the intention behind the paragraph which suggested that Mr. Townend's advice be followed. The writer was not visualising that Mr. Bradshaw should take that advice, but that one of our research departments, either the N.P.L. or Farnborough, should devote a certain amount of time to examining the problems relating to oscillating wings.

The apparent inconsistency referred to by Mr. Bradshaw was due to lack of space in which to deal with the technical aspects of the

"Katzmayr Effect." The note by W. L. Cowley (R. & M. No. 969, written in March, 1925) explains that Katzmayr made three distinct sets of experiments. In the first, the average values of lift and drag were measured when the angle of incidence of the model was varied in a steady horizontal wind; in the second, the model wing was made to oscillate up and down bodily; and in the third, the model wing was fixed, but the direction of the wind was varied by means of vanes, changing from an upward to a downward slope alternately.

Katzmayr found that in the first set of experiments the L/D ratio diminished as the oscillations increased in amplitude, but that altering the frequency had little or no effect. In the second set of tests it was found that the polar curves were not quite so favourable as when the model was at rest.

In the third set of test Katzmayr found that there was considerable improvement with increasing amplitude, and negative values for the average drag were obtained, in some cases for relatively large values of the average lift.

Three French experimenters, Toussaint, Kerneis and Girault, tried the effect of combining the motions of experiments one and three, but concluded that no improvement could be obtained in that way. Cowley does not, however, accept this conclusion as a general one, and points out that by having the two motions suitably out of phase, a very large improvement should be possible.

From these considerations it is concluded that, from the point of view of getting the maximum energy out of a "bumpy" wind, the waves should be large in relation to the chord of the wing, but from the point of view of the wing itself, its oscillations should be smaller than those associated with bird flight.—Ed.

THE "KATZMAYR EFFECT"

IN *Flight* of July 15 a highly interesting article appeared about man-power flight, further commented on in "The Outlook." Attention is called to the "Katzmayr Effect." Now, there is some difference between the K.E. and a flapping wing, in so far as the latter must have the highest K.E. at the wing-tip and no effect in the middle of the wing. In my opinion, the whole thing must have something to do with the tip vortex. The ease with which birds "row" with their wing-tips must be explained by the way they make use of the tip vortex as they move the tips in an opposite direction to the air circulation. In this way they not only have a propeller of the highest efficiency, but at the same time partly neutralise the tip vortex, which has the same effect as if the wings were of extremely high aspect ratio.

In this respect I would like to draw your attention to the fact that birds that specialise on soaring flight, like the albatross, have a very high aspect ratio, whereas "rowing" birds, even long-distance flyers, have a much smaller ratio (apparently because of their "rowing" a high ratio is not wanted).

If the above is true, it would be very interesting to carry out experiments with models or even gliders with wing-tips capable of both torsional and flexural oscillation. In my opinion, only 40 per cent. of the wing needs to make this movement. However, the only question that remains is how to construct such a wing.

H. C. VAN ODIJCK.

Amsterdam.

SAILPLANE FIGURES

I HAVE read Mr. Bradshaw's article on "Man-Power Flight" with much interest, and as he invites comment from readers with experience of modern gliders, I would like to criticise the figures he gives for a possible glider which he uses as a basis for his proposed man-power machine.

Starting with his estimated weight of 80 lb. for a glider: An intermediate-type glider which I designed about 1930, called Scud I, was, I believe, one of the lightest and smallest soaring gliders that has been made. It weighed 103 lb., was of 25 ft. span, and had a gliding angle of about 1 in 14 at 30 m.p.h., that is, a sinking speed of about 190 ft./min.

Mr. Bradshaw's weight of 80 lb. looks, therefore, a possible figure, but he also supposes that such a glider would have a gliding angle of 1 in 30 at 8 m.p.h., which is, as he says, a sinking speed of about 24 ft./min.—in other words, an efficiency eight times that of the Scud I, which means that a Scud I would require eight times the power for level flight. Also, if Mr. Bradshaw's machine has a flying speed of 8 m.p.h. only (which would certainly be necessary to give this phenomenally low sinking speed) the wing area would have to be nearly sixteen times as great as that of Scud I, i.e., 1,280 sq. ft. This would rather upset the 80 lb. weight estimate.

Examples of more highly efficient sailplanes which I have designed and which more nearly approach Mr. Bradshaw's gliding angle (but not sinking speed) figures include the Scud II which holds the British height record of 8,323 ft. This was of 40 ft. span, had a gliding angle of about 1 in 18 at 30 m.p.h., sinking speed 150 ft./min. and weighed about 190 lb. It was lighter than other machines of its class. More recently there was Scud III, which may be classed among the highly efficient modern sailplanes. It has a span of 45 ft., weighs 260 lb., has a gliding angle of 1 in 22, and sinking speed of about 120 ft./min. This value of sinking speed is just about as good as is being obtained with modern sailplanes, but is still about five times greater than that of Mr. Bradshaw's machine. It will, therefore, require five times the power for level flight, assuming it weighs only 80 lb., but it weighs 260 lb. (which is lighter by at least 50 lb. than most machines in this class). So, if we add 180 lb. to Mr. Bradshaw's gross weight figure of 230 lb. we get 410 lb. Thus our figure of five times more power required becomes $5 \times \frac{410}{230} = 8.9$ times more power required, which compares with eight for a machine of Scud I's weight and sinking speed.

It can be seen, therefore, that whichever end of the scale we take figures of known gliders, whether of large span and weight and low sinking speed, or small span and weight and higher sinking speed (sinking speed being proportional to span/weight ratio, and power required to sinking speed and actual weight), the power required for level flight is about eight times that supposed by Mr. Bradshaw.

It may also be of interest to mention that Scud III was also fitted with a retractable auxiliary engine unit when it was known as the Carden-Baynes Auxiliary. The engine was a 250 c.c. Villiers, which gave 8-9 h.p. at best at 3,500 r.p.m. with an airscrew efficiency of not more than about 50 per cent.; that is, we had perhaps 4 thrust h.p. I believe this is actually the lowest-powered machine which has been made to leave the ground under its own power and fly successfully.

The purpose of the auxiliary engine was to enable the machine to take off without launching gear or hill-side up-current being necessary and climb to a sufficient height for thermal or cloud soaring to be possible. The engine was then stopped and the engine unit retracted into the neck of the fuselage. The engine unit with gear added about 50 lb. to the all-up weight, or about 10 per cent., which is about 5 per cent. increase in sinking speed or power required for level flight. The thrust h.p. available for climb was about 1.5 and the power required for level flight about 2.5 t.h.p. or 5 b.h.p., which is about eight times man-power (not Bradshaw power!).

With regard to Mr. Bradshaw's assumptions on man-power, can it be assumed that if a man can deliver ½ h.p. with his arms and ½ h.p. with his legs, he can necessarily deliver a total of 1 h.p. if both arms and legs are working at the same time? For instance, could a man, pumping up a motor tyre with one hand, do this just as well if he was pumping up another tyre with another pump with the other hand, and two other tyres with two foot pumps with his two feet, all at the same time?

L. E. BAYNES.

Heston.

THIS RECORDS BUSINESS

I TRUST you will forgive me referring to a matter which is now somewhat out of date. Owing to my being away at the time I did not get my copy of *Flight* for June 10, and so did not see the letter from Mr. Ronald Walker, in which I was challenged to plead that I was misreported. There was no need for your correspondent to have issued his challenge, as I have not the slightest intention, either now or at any other time, of withdrawing any remarks I made about the Royal Aero Club, or any other club for that matter. If Mr. Walker had troubled to make further enquiries, instead of rushing into print and issuing challenges, he would have found it was so.

What I was attempting to explain was that my remarks had nothing to do with the fantastic interpretation that was put on them, in which I was practically accused of casting aspersions on other record breakers, and bewailing the fact that I did not get my fair share of publicity, both of which assertions are so absurd as to require no answer.

Record breaking is, after all, such a small part of aviation that surely it can be spared spiteful and sarcastic remarks such as these, especially when they are not true.

As to "falling back on the old defence of being misreported," I in turn will challenge Mr. Walker, or anybody else, to testify that I ever at any time said "We Yorkshiremen are a tough lot," or "Pioneer flights such as mine," etc., etc. Although such remarks are absurd, they nevertheless appeared in numerous newspapers as having been said by me, so apparently there is just a chance of being misreported at times.

All of which points to the same old story—do anything out of the ordinary and there is always somebody kind enough try to pull one down; this appears to be especially so in the case of record flyers.

Harrogate.

H. L. BROOK.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

IT is understood that the King may fly to Suffolk in the Royal Envoy this week. This would be his first flight since his accession.

Mr. Whitney Straight has offered his services to the Boy Scout movement in helping Scouts to form air patrols near his aerodromes at Ramsgate, Ipswich and Exeter.

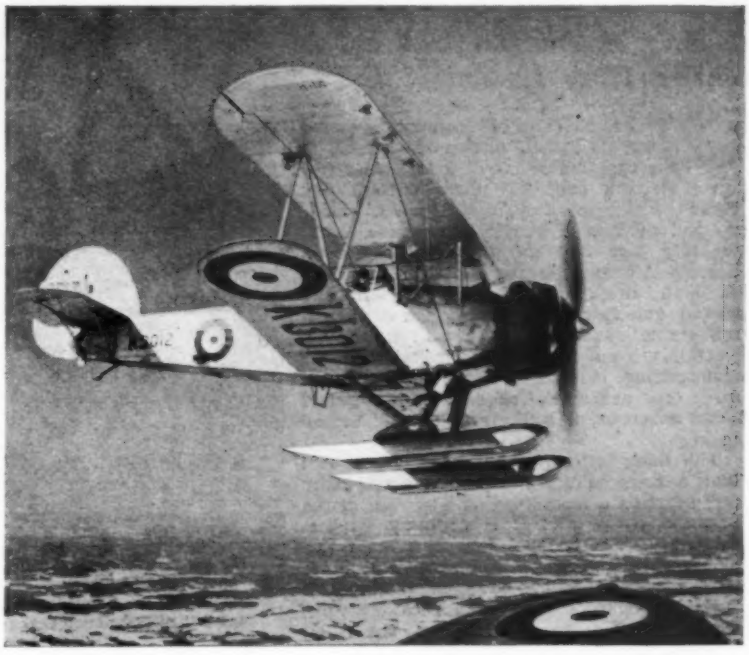
According to a report issued by the U.S. Bureau of Air Commerce an electrostatic spark, igniting a mixture of free hydrogen and air, "probably" caused the destruction of the airship *Hindenburg*.

It is reported that flying-boat construction will begin next month at the factory now being completed at Dumbarton by Blackburn Aircraft, Ltd. The Clydeside works cover an area of 300,000 square feet and will employ 2,000 hands.

An advance party of technicians and general office staff from Brough are already in possession of their new quarters. Sir Maurice Denny, Bt., chairman of William Denny and Bros., Dumbarton, has joined the Blackburn board.

Readers holiday-making in the Isle of Wight next week, and all interested in yachting, should note that two special numbers of *The Yachting World* are to be devoted to Cowes Week. In the first of these, on sale to-morrow, are outlined the prospects for the event.

On the spans of the world's longest bridge across San Francisco Bay between Oakland and San Francisco are six huge beacons for guiding aircraft entering and leaving the harbour. The lenses are 24 in. in diameter and contain two 1,000-watt lamps. So that the bridge operators will know that the beacons are functioning properly their revolutions are visibly indicated on a control board in the Administration Building.



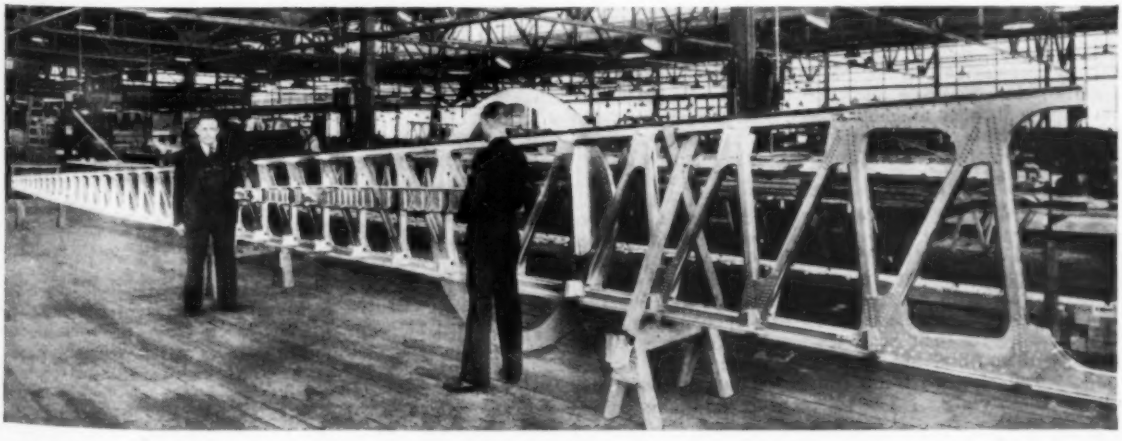
OUT IN THE COLD, COLD SNOW — : A Special Hart with Perseus sleeve-valve engine, skis and cockpit enclosure on test with the Royal Canadian Air Force. In the foreground is a wing of a recently acquired Northrop Delta.

Two Austrians, Herr Marek and Herr Emmer, have established a new altitude record for hot-air balloons by reaching 24,700 ft.

M. Pierre Cot has inaugurated at Nantes the first military aircraft factory built since the nationalisation of the French arms industry.

Rumania has ordered twenty-four Savoia Marchetti S.79 bombers capable, it is believed, of well over 250 m.p.h.

Two members of the Harvard Institute of Geographical Exploration were flown to a base camp on a glacier and subsequently scaled two Alaskan peaks, one being 17,150 ft. high.



SPAR OF A CLIPPER : A spar for the 152-foot wing of the 72-passenger Boeing Pan American Clipper (four two-row Cyclones) compared with that of a P-26A pursuit machine. The Clipper should be finished late this year. It will weigh 82,000 lb.—about twice as much as an Empire boat.

COMMERCIAL AVIATION

THE WEEK AT CROYDON

Much Ado About Undercarriages : Minister of Transport Gets a New Angle on Roads : "Gating" the Boys

OWING to shortage of blood-curdling news items, no doubt, certain newspapers of the type whose bright lads always ring up and say, "If there weren't any blood splashes, old boy, it isn't news," made no end of fuss of the by no means extraordinary fact that an aeroplane of North-Eastern Airways, on the Croydon-Doncaster-Scotland run, returned to Croydon and landed quietly and without incident with a retractable undercarriage jammed in the up position. Enough wheel protrudes when the undercarriage is retracted for the landing to be made on pneumatic rubber, anyway, and metal airscrews, if bent, may be straightened again.

The thing is less alarming and sensational than a news editor, in bowler hat and baby car, bursting a front tyre on a stretch of the Brighton Road, and it is certainly far less dangerous. I believe the N.E.A. traffic manager very painstakingly explained things to the newspaper people most addicted to "writers' epilepsy" on such occasions, but "drama" was on the bill of fare, and "drama" we got, served with a trowel instead of a dessert spoon. Some of the older generation of news editors should cease, about now, to gamble on public ignorance of aviation, for every schoolboy knows far more about it than they do and, more important still, several newspaper bosses own their own 'planes and are beginning to have an inkling of what it's all about.

Much fun used to be had by all in the early days when undercarriages were rigid unless something broke. Capt. Jimmy Youell once landed a fully loaded Argosy at Croydon on one wheel so skilfully that passengers did not realise there was much wrong, and one old lady irately asked what he had come back for. Another much earlier case was that of Commander Scholte, K.L.M., one of whose wheels came off just as he had gained flying speed in the take-off at Croydon. It was in the days before wireless communication with aircraft, but a 'phone call to Holland caused legends to be writ large in whitewash on the aerodrome and another aeroplane to be sent up to signal with a spare wheel, and Scholte brought off a remarkable "one-point" landing, so that practically no damage resulted. Those were the days for news hawks.

Survey in High Places

Imperial Airways have been giving Mr. Burgin, Minister of Transport, and his experts a view of the road systems of England from aloft. This is the first time, I understand, that it has been known officially whether Belisha beacons were bald on top or not, and a great deal of other useful information was apparently acquired when the experts saw their road system laid out like a map beneath them; and not only that, but a living, moving map as well, showing traffic congestion and the possibility or impracticability of by-passing at certain key points, and so forth. A D.H.86 was used, and the first of what may be a series of aerial road surveys was from London, up the Great North Road and back *via* Carlisle, Preston and Coventry. Another contemplated route is London-Penzance and back *via* Brighton. As one of those who helps to pay the cost of these air trips, I hope some good will come of them.

"HERACLES," best known of Imperial Airways' H.P. 42's, last week celebrated her 1,000,000th mile in the air. The story of the celebration party appears on the next page.

There is a gate the function of which is to allow passengers and others to approach the main buildings without a long detour *via* Purley Way when leaving the Aerodrome Hotel. Owing to some obscure idea that a gate exists mainly to be shut and locked at intervals, the authorities wait until highly inconvenient times and then suddenly lock it, especially in rainy weather, when there is a huge puddle each side of the gate. One day an exalted passenger's white spats will be ruined by fruitless wading, and an important air connection will be missed. Even the remotest and most tradition-ridden mediæval walled cities have ceased to lock the traveller in and the inhabitant out at sundown, so Croydon might stop this archaic practice, which infuriates everyone and actually interferes with the business of transport operators.

About eighty Air Ministry employees from London came here last week to see how and where this civil aviation was performed. Idle bystanders were much amused at their naïve comments. However, most of them flew by Surrey Flying Services and returned later to Whitehall to commit further legislation for commercial aviation. Whether a little knowledge will prove a dangerous thing remains to be seen.

American Aircraft and Engine Service, Ltd., recently erected a couple of Stinsons for clients of Brian Allen Aviation, Ltd. One, for Mr. Leslie Irvin, has a constant-speed airscrew. [An illustration of the instrument panel appears on p. 129.—ED.] Those responsible for erecting these machines are loud in their praise of the simplicity of the operation. No jig-saw puzzles, and things really fit where they are meant to go. One Stinson, still crated at 3 p.m. on Thursday, was erected and engine-tested by Friday evening, and test-flown on Saturday morning early.

A. VIATOR.

"HERACLES," MILLIONAIRESS

WHILE it is not difficult to picture *Heracles* carrying Cerberus from Hades to the upper world (he does it every day, at £6 10s. a time ex Croydon), one finds it harder to visualise him catching a Hind—which, if you remember, was another of his Twelve Labours.

In spite of his illustrious name, we prefer to think of him as a dear old lady. A nice fat, comfortable, easy-going old lady, kindly tolerant of those skittish, smooth-skinned young things who go screaming past her on the way to Paris.

On Wednesday of last week *Heracles* had a birthday party to celebrate her completion of just one million miles in the service of Imperial Airways, during which six-year period she has carried some 80,000 passengers in comfort and safety. Her employers were there, represented by Sir Samuel Instone; her makers, by Group Capt. Maycock and Mr. J. Hamilton, of Handley Page's; the Brenards, *père et fils*, acted as M.C.s on behalf of Imperials; and Capt. F. Dismore, First Officer Jeffreys and Wireless Operator Raeburn kept the party going—in the strictly literal sense.

Taking off from Croydon shortly after 1 p.m. in QBI conditions (and what an unexpected surge of acceleration the four 555 h.p. Bristol Jupiters still bestow!), *Heracles* ploughed relentlessly up through 4,000 ft. of cloud, then cruised south-west at 6,000 ft. at her own staid and comfortable gait while Stewards Baikie, Hart and Smith dispensed a five-course lunch as excellent as any we have ever enjoyed on land, sea or air.

At the millionth mile Capt. Dismore (having, it is to be hoped, checked up the fact carefully with C.D.C. and log-book) made the rounds of the ship and joined the passengers in a champagne toast to her.

Turning ten or so miles beyond Southampton, *Heracles* boomed majestically homewards, circled London while awaiting permission to enter the control, then sank out of the sunlight into the murk of an English summer. The party was over.

For the data-addicts who were in their kindergartens when *Heracles* and her seven sisters were born, we may add: Length, 89 ft. 9 in.; span, 130 ft.; gross weight, 30,000 lb.; maximum speed, 127 m.p.h.; cruising speed, 95 m.p.h.; passengers, 38-40; crew, 5-6.

Customs at Leicester and Exeter

ON July 19 Leicester airport was officially opened for Customs by the Lord Mayor (Councillor A. H. Swain, J.P.), who had himself flown from Deauville in Mr. Lindsay Everard's Vega Gull. Such facilities are now available, too, at the new Exeter airport

Gatwick De-zoned

SINCE the Gatwick radio station has now been closed, the controlled zone surrounding this airport is no longer in operation. At the same time the operation of the Lorenz short-wave approach system has been discontinued, though this may still be used for experimental approaches at certain times.

Over the Western Isles

A NEW private company has been registered in Edinburgh under the style of Western Isles Airways, Ltd., "to establish, maintain, and operate lines of aerial conveyances in any part of the world, and to carry on business as conveyors of passengers and goods of all descriptions." One of the subscribers is Mr. George Nicholson, managing director of Northern and Scottish Airways, Ltd.

Pilots' Association

ON Monday of last week the results of the executive council ballot were announced at a special meeting of the newly formed British Air Pilots' Association. Mr. E. Lane Burslem was elected chairman, while many of the best-known transport and charter pilots found themselves on the general council. Among these are Messrs. W. Rogers, E. B. Fielden, V. E. Flowerday, C. W. H. Bebb, F. R. Midgley, T. W. Morten, D. Boitel Gill and P. W. Lynch Blosse—to mention a few.

Movements in Ceylon

AT long last Ceylon will have its air connection with the main trunk route, and the new Ratmalana airport is to be put to work. The Indo-Ceylon air mail is due to start in December this year. Tatas, of Bombay, will use Wacos for their service and when the Empire Air Mail Scheme is complete Ceylon will have five services each way. The time schedule between London and Colombo will be five days.

The Aero Club of Ceylon is expected shortly to obtain a subsidy, but in the meantime the club has secured honorary instructors and engineers from the flying staff of the East Indies Squadron. The Gipsy Moth owned by a syndicate of seven members now takes the air regularly and the Tiger Moth given by Lord Wakefield has been assembled and should by now be in the air. By the end of next year night flying equipment will be installed at Ratmalana aerodrome.

Meanwhile, Tatas are awaiting the Government's approval of the details of a projected air service linking Bombay, Delhi, Lahore and possibly Kashmir. The proposal is for a service between Bombay and Delhi, taking Gwalior and Jhansi *en route*. Jhansi is on the new trunk route.

Danish Link

DET DANSKE LUFTFARTSELSKAB, the Danish operating company, has now opened its second air line. This, between Copenhagen and Esbjerg, is designed to act as a feeder service for boat passengers between Harwich and Esbjerg, where a new airport has just been officially opened.

National airline number one, which was opened last autumn, is that between Copenhagen and Aalborg.

More and More Boats

A GLANCE at one of the recently published "Air Mail Movements" shows how the Short boats are slowly but steadily replacing the older landplanes on the Empire routes. On July 19, for instance, there were no fewer than eight of them making progress towards Durban or on the Mediterranean service, while there were only seven landplanes. The boats concerned were: *Centaurus, Challenger, Cygnus, Cariolanus, Calpurnia, Courtier, Cassiopeia* and *Castor*. Two others, *Caledonia* and *Cambria*, are, of course, reserved for long-range experiments. *Cavalier* is in Bermuda, and *Canopus, Ceres, Capella, Corsair* and *Centurion* were presumably laid up for servicing.

Those Belts

AN amendment is shortly to be issued to A.N.D.13 concerning safety-belt provision in aircraft. Normal machines must be provided with a safety belt for every seat used by the crew, with a lap strap for every other seat. Machines in the aerobatic category must carry a safety harness for every seat.

The need for safety harness in every machine used for aerobatics is an obvious one, and in spite of the opinions of several airline operators, we have always felt that the use of lap straps in all transport machines shows more practical advantages than psychological disadvantages. During the take-off and landing, and in bumpy weather, such fittings are of definite value.

"Please, It Was Only a Short One"

THE design of a new clubhouse for the Kuala Lumpur (F.M.S) Flying Club, about to be built, will probably be unique in conception. According to a correspondent, the building is to resemble in shape and appearance a Short Empire flying boat, with cabin windows and door. The "door" will be an entrance through which cars will be able to drive, and to its left will be the offices, bar and lounge. A stairway will lead to committee rooms and a flat-roofed terrace above, giving the impression of the wings of a monoplane. The building will measure 75 feet from "nose to tail" and "wing-tip to wing-tip," while "slender steel-blue columns will resemble wing-stays"—which is where the analogy seems to have come unstuck; wing-tip floats would be more to the point.

The idea seems to have its dangers. One of these days we shall find an Imperial pilot landing a club-house on Southampton Water, and the thing will take an awful lot of explaining away.

Commercial Aviation

France's Internal Air Mail

AIR France have had a large share in the reorganisation of the internal air mail system of France, and the combine now holds an equal number of shares in the newly constructed Air Bleu Company with the shareholders of the old company —viz., 24 per cent. each. The remaining 52 per cent. is held by the French Government.

Since July 7 Air Bleu have been carrying about 300 lb. of mails daily by air inside France, using three Caudron Simouns. Everything has worked satisfactorily. Three different routes are flown, each starting from Le Bourget. They are: (1) Le Bourget, Bordeaux, Mont de Marsan, Pau; (2) Le Bourget, Toulouse, Perpignan; (3) Le Bourget, Clermont-Ferrand, Lyons, Grenoble.

Hands Across the North Sea

ANOTHER step to establish the new Tyne-Norway air service, sponsored by Allied Airways (Gandar Dower), Ltd., was taken when the Mayor of Stavanager (Ordforer M. Michalsen) and five members of the Stavanger Airport Committee flew over to spend two days on Tyneside.

They were the guests of the Deputy Lord Mayor of Newcastle (Councillor R. J. Richardson) and the Sheriff (Councillor A. D. Russell) at dinner in the Mansion House, Newcastle, on Wednesday of last week, when Mr. E. L. Gandar Dower disclosed that his company intends, next year, to push a line even farther than Stavanger.

Mr. Gandar Dower, after making his announcement of this proposal, said that with regard to the Tyne-Norway service they had set themselves one object—to finish the season with a complete record of safety. His company had operated an air line for several years and during that time none of the passengers carried by its aircraft had been injured.

Before leaving on the return flight on Thursday, the Mayor of Stavanger told *Flight's* contributor that he had been very much impressed with the comfortable crossing in the D.H.86B. "I have little doubt that this service will be a big success," he said. "We, in Norway, feel that it is a great pity that your Government are not permitting the service to carry the mails, as we are doing. Perhaps, however, that will come in the near future."

On the return flight, *The Norsemen*, piloted by Eric Starling took advantage of a strong tail wind to arrive at Stavanger in 2 hours 35 minutes, which was 35 minutes inside schedule.

High-speed Charter

NEXT year may see the appearance of a charter company using a fleet of 200 m.p.h. machines for special work. Mr. F. C. Chamberlain, who has gained his experience with Imperial Airways, Bancos and North Eastern Airways, is at the back of the scheme, the headquarters for which are at 40, Shaftesbury Avenue, London, W.1.

Whilst his main idea is to provide for the needs of those who wish to get from place to place in the shortest possible time at a moment's notice, he may also operate summer holiday services, and will not attempt to cut into the fields of charter concerns already in existence. Where work is already being done by these concerns, his fast machines will be sub-contracted to them when really fast transport is demanded by their clients. The need for such a charter company is there, and it remains to be seen whether business of this nature will be forthcoming in sufficient quantities to justify the fairly heavy outlay involved.

AIR FRANCE'S FASTEST

The Bloch 220 : A Sixteen-passenger Monoplane Adopted as Standard Equipment

THE first Bloch 220 high-speed twin-engined monoplane of a series ordered by Air France was put into regular service last week. Flown by Gaston Durmon, Air France's chief pilot, the machine made the Paris-Marseilles-Paris round trip at an average speed of 179 m.p.h. which is 8 m.p.h. faster than its official cruising speed at 58 per cent. power. In the first instance all the 220s will be put on the Paris-Marseilles route (two services daily) replacing the high-wing Potez 62s.

The wing of the 220 measures 73 ft. in span and has an area of 780 sq. ft. Built in three sections it has two spars and a stressed metal skin. Flaps and ailerons are electrically operated.

A semi-monococque structure, the metal fuselage is sixty-one feet long and has straight sides. The forward portion seats six and the rear section ten. Dimensions are: length (two sections) 26 ft. 7in., width 5 ft. 6 in., height 9 ft. 6 in.

The retractable undercarriage is operated by compressed air.

Empty, the Bloch 220 weighs 12,980 lb.; the gross weight is 19,759 lb. With the two medium supercharged Gnome Rhone fourteen-cylinder 880 h.p. two-row radials at full throttle (they drive electrically operated Ratier airscrews) a speed of 219 m.p.h. is attained. The range and cruising speed are respectively 1,200 miles and 171 m.p.h.

Seeing Round

ONE hundred and fifty members of the Coventry Engineering Society were recently entertained by the Lockheed Hydraulic Brake Co., Ltd., and conducted on a tour of the Leamington works. They inspected a special display of the firm's products which included aircraft remote controls, undercarriages, and hydraulic operating gear of many different kinds.

A Bristol "Shadow" Factory

AT the annual meeting of the Bristol Aeroplane Co., Ltd., last week, Mr. W. G. Vernon Smith, C.B.E. (the chairman), said that the directors had brought up the general reserve to £1,000,000 and recommended the payment of a final dividend of 15 per cent., less income tax, making a total distribution for the year on the enlarged ordinary capital at the rate of 22½ per cent.

It was stated that during the past year the company's manufacturing resources had been employed to their maximum capacity. Such accomplishments as the Bristol Hercules 14-cylinder sleeve-valve engine (the most powerful British aircraft engine so far type-tested) were mentioned, and the company looked forward to large sales of sleeve-valve units at home and abroad. Bristol engines were being manufactured under the Shadow Scheme by a group of five of the principal motor car manufacturers. At the request of the Air Ministry the Bristol Company itself had also joined the group and had undertaken the erection, equipment and management of a shadow factory entirely separate from the Company's ordinary aircraft business.

The Blenheim was in active production at the Bristol works and a leading motor car company had been entrusted with the equipment of a shadow factory in which to build these machines. Another concern had also received a contract to produce Blenheims.

Mention was made of the new company, Rotol Airscrews, Ltd.,—a joint Bristol-Rolls-Royce venture—and to the height records achieved by Sqn. Ldr. Swain and Flt. Lt. Adam, and the performance of the Bristol engines in the Empire flying boats, culminating in the recent two-way trans-Atlantic crossings.

ALL OUT ALONG, DOWN ALONG...

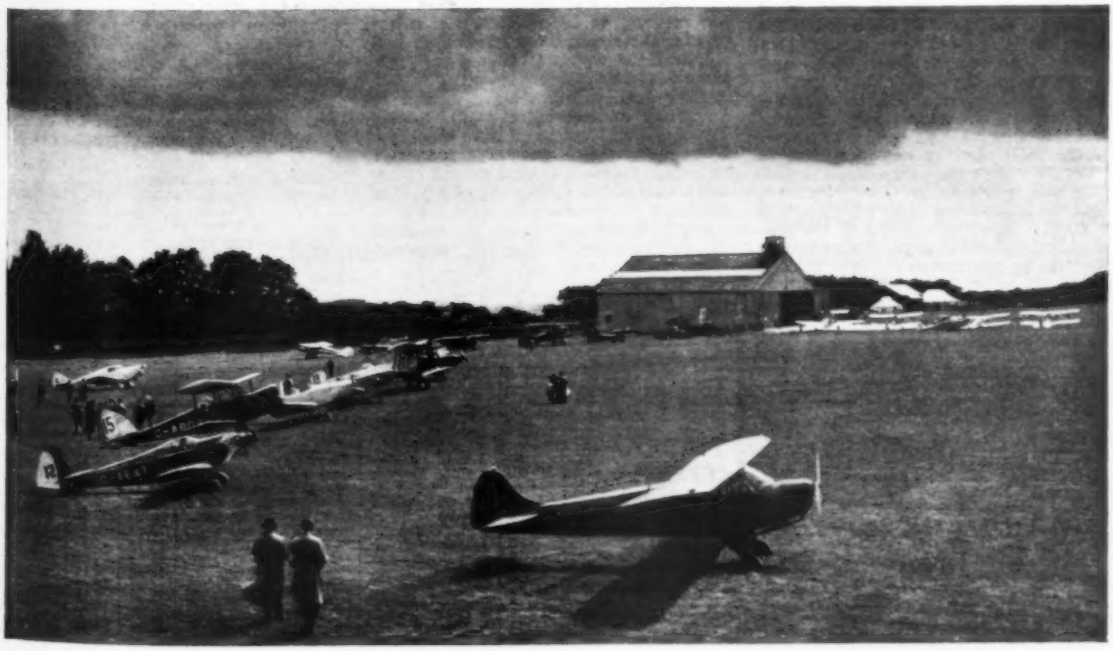
Veteran Avro 504N Wins Devon Air Race: 35,000 See Some Tripartite Aviation

Capt. Percival Phillips and Mrs. Phillips in front of the victorious Lynx Avro

THE intrepid air racer who would catch out Handicappers Dancy and Rowarth must nowadays enter some really unlikely aircraft—say an Empire flying boat or a navigable balloon. Alternatively, he may produce a type which has not run the gauntlet of their slide-rule in years. And that is what the winner of last Saturday's Devon Air Race did. Capt. Percival Phillips, with one of the banner-towing Avro 504Ns of Air Publicity, Ltd.—but without the banners—successfully threw a spanner into the works of the official stop-watches, whose owners admitted that they couldn't remember encountering a 504 in a race since 'way back in 1927.

Mr. Whitney Straight, Lt.-Col. Louis Strange and their henchmen addressed themselves to a Herculean task in organising simultaneous air displays at the three of their airports, Plymouth (Roborough), Haldon (Teignmouth) and Exeter, which formed the corners of the triangular 77-mile course. A study of the operational schedule, with its split-second plans for pushing racing aeroplanes, demonstrating aeroplanes and a couple of R.A.F. formations round all three aerodromes in three hours or so, brought on slight vertigo in the reportorial brain.

Boggling slightly at this idea of being in three places at once, we confined our attention to Plymouth, the start and finish of the race. Proceedings began with demonstrations of, *inter alia*, the Dart Kitten (Mr. Alington), Aeronca (Mr. F. T. Lett) and Miles Whitney Straight (Mr. Gordon Marshall). At 2.30 p.m. three Saro Londons from Mount Batten put in a deep-throated appearance and showed themselves at



The start: P. B. Elwell's Taylor Cub is seen getting away, and Alington's Dart Kitten is next in the line.

close quarters (flying boats near the grass always seem exciting—the old blood-thirsty instinct again, one suspects, though they do say that a flying boat, *in extremis*, can be made to slide along on its bottom quite gracefully).

The programme informed us that the race would start at 3.30 p.m., and, on another page, that the competitors should reach the first turn (Haldon) at approximately 3.25, which rather suggested an entry by the proverbial Young Lady named Wright, who Travelled much Faster than Light. However, 3.30 it was when the first machine, P. B. Elwell's Taylor Cub, was despatched over a course as interesting as any this season.

The first leg to Haldon, 28 miles on a track of 80 deg. magnetic, took the competitor on a steady climb up and over high moorland, with the sea on his right, then down to the turning point, and left on to 37 deg. for the 12 miles to Exeter, with a chain of church towers as checks. An acute left turn round Exeter Airport circle took him on to 247 deg. for the straight homeward leg of 37 miles from Exeter to Plymouth. This last stretch—up-wind, and therefore flown at negligible altitude by the majority—lay over the heart of Dartmoor, but, even here, landmarks were not lacking, there being several odd ponds and clumps of rock, not to mention Widecombe and Old Uncle Tom Cobleigh and all. Fortunately, some murky stuff which threatened to shroud the tors cleared just before the start; otherwise there might have been a more eventful tale to tell.

Ticklish Take-off

Devon is not exactly a level area, Plymouth Airport partakes of the nature of the country, and the prevailing wind called for a take-off from distinctly rising ground. Fortunately, there was a useful breeze to assist the process of divorce. Nevertheless, some people were faced with problems; Miss Connie Leathart, for instance, dare not lift the tail of her Comper Swift too much for fear of the airscrew digging in, and Alex Henshaw nested the Mew Gull's tail firmly in the hedge in order to obtain the longest possible run. His departure—from scratch, of course, forty minutes after the Aeronca—was curious to watch for the little machine disappeared right out of sight over the hump, still showing little inclination to unstick. Just beyond the hump lay a main road and lots of trees. Everybody watched the sky over the hotel which formed the turning-point on to the course. Not a sign of the Mew for what seemed like whole minutes! Then we spotted it—disappearing straight eastwards, dead on its course and at a prodigious rate of knots, apparently among the trees in the fields behind the hotel. Alex Henshaw (who, by the way, always wears a parachute, for you can't put down the Mew Gull just anywhere) certainly has this air racing business buttoned up.

The fifteen starters (one absentee—S. T. Lowe) got away without incident, however, though Messrs. Rowarth and Dancy did have to hold two machines back, and adjust their timing accordingly, because somebody in a Monospar chose that inopportune moment to put down in the take-off area.

Not ten minutes after Henshaw had left, Exeter telephoned a tale of close processions that promised a solid bunch at the finish. Glasses were focused on the moorland skyline—and their owners missed seeing a 504 Avro which suddenly materialised, large and close, out of the patchwork background of the climbing hillside. Capt. Phillips, with his wife as passenger in that worthy veteran, had fairly walked away with the race, averaging 103 m.p.h. It was over three minutes before Miss Leathart's Swift crossed the line to snatch second place (at the excellent figure of 120 m.p.h.) from Leech, in the Spartan Arrow, by a matter of 2 sec. Tommy Rose was a good fourth, 18 sec. later, and most of the others were well up.

Capt. Phillips told us that he had so much faith in his old Lynx, that, whereas his normal cruising speed is 85, he put the throttle lever hard against the stop and left it there, with 102 on the A.S.I.; and his average of 103, taking the wind direction into consideration, suggests that his air speed was actually higher. The only change he had made by way of transmigration from banner-towing to racing was to fit another airscrew. Well, if anybody ought to have faith in his engine it is Capt. Phillips, who, as a director and chief pilot of Air Publicity, Ltd., spends much of his life extolling in letters of fabric, if not of fire, the merits of prophylactics and whatnot for teeming millions of pale Londoners below.

Everyone, at the finish, seemed to have had an uneventful trip, though Tommy Rose claimed to have shot-up a brace of "eagles" over Dartmoor [more probably gaol-birds.—ED.], and somebody else accused an overtaking competitor of having cocked a snook at him.

Lord Fortescue, Lord-Lieutenant of Devonshire (who, incidentally, is understood to be pleading for the formation of a County of Devon Auxiliary Squadron) presented a right noble array of prizes—the Devon Air Trophy and £50 to the winner, a trophy and £25 to the second, and a trophy and £10 to the third, plus the Teignmouth Air Trophy to Henshaw for fastest actual time, and a special *concours d'elegance* award to Geoffrey De Havilland for the nice finish on the T.K.2.

Meanwhile, demonstrations continued: Mr. Hollis Williams had brought down the Monospar ambulance, and Mr. Noel-Brown superintended a rescue display. Mr. Wikner demonstrated the Wicko. Then a flight of Gauntlets of No. 54 (F.) Squadron, all the way from Hornchurch, provided the aerobatic high spot of the day with a brilliant display that must have fairly staggered Devonians familiar only with the comparatively staid evolutions of the Mount Batten boats.

And by that incredible piece of organisation these spectacles were being repeated at the other two aerodromes. The organisers had their reward in the measure of success indicated by the attendance figures . . . 7,000 at Haldon, 8,000 at Plymouth, 30,000 at Exeter . . . as many again crowded out . . . a three-mile traffic jam . . .

Incidentally, no admission fees were charged, and joy-riding had to help cover the expenses; with every available machine pressed into service, 876 people were carried at the three aerodromes. The Whitney Straight organisation can, one feels, safely claim to have put long-overdue Devon on the air map.

Briefly . . .

A dance at Teignmouth provided relaxation after the heat of battle.

Sights we should like to see: Papa Henshaw in the Mew Gull.

Mr. Brian De Greeuw made parachute descents, by G.Q., at Exeter and Plymouth.

John Grierson, of Greenland flight fame, flew his wife's Mark I Swallow into seventh place.

Overheard (genuinely): "Look, George, it hasn't any wheels." "No, dear, they always take them off for racing."

Marks to Mr. Whitney Straight's programme editor, who tells the public something for sixpence—and tells it intelligently.

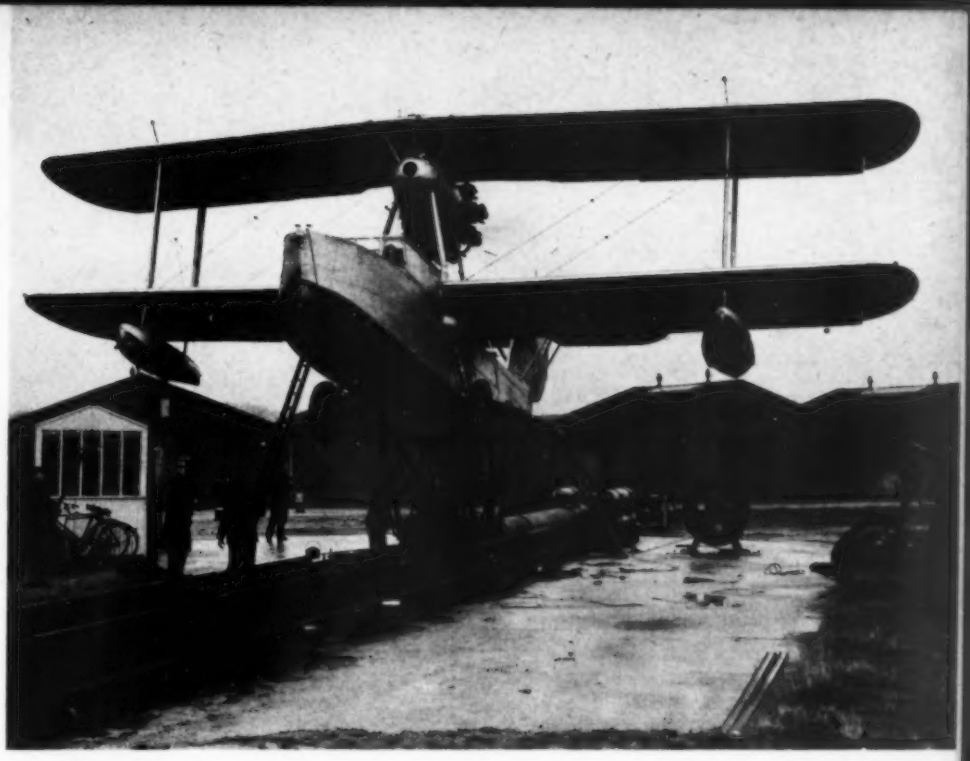
The Western Bros.' Swallow finished last—but Kenneth seemed to have Let the Side Down, Chaps, for only George was in evidence.

One of the organisers, Lt.-Col. L. A. Strange, is none other than the famed R.F.C. pilot who, fighting a German at 8,000 over Ypres in 1915, suddenly found his Martinsyde out of control, was flung out of his seat, and spun down 5,000 feet hanging from the Lewis gun mounting. He eventually got the machine under control with his feet.

Alex Henshaw, with the Mew Gull, added another line to his long list of "fastest times" by averaging 208 m.p.h. He finished sixth.

RESULT.

Race No.	Pilot.	Machine.	Starting Time.	Nett Time.	Speed.	Placing.
			m. s.	m. s.	m.p.h.	
16	P. B. Elwell ...	Taylor Cub (Continental)	0 0	66 12	69.50	14
12	C. G. M. Alington	Dart Kitten (J.A.P.) ...	7 50	56 40	81.00	12
15	F/O. Leech ...	Spartan Arrow (Gipsy I)	12 22	49 15	93.25	3
2	Miss G. Batchelor	B. A. Swallow (Cirrus)...	13 23	52 10	88.00	13
9	Geo. Western ...	B. A. Swallow (Cirrus)...	13 23	56 51	80.75	15
18	Capt. Phillips ...	Avro 504N (Lynx) ...	14 22	44 33	103.00	1
3	John Grierson ...	B.A. Swallow (Cirrus)...	15 18	47 16	97.25	7
7	Capt. Symondson	D.H. Moth (Gipsy I) ...	17 4	46 28	99.00	9
6	Miss Leathart ...	Comper Swift (Pobjoy)...	23 16	38 19	120.00	2
10	R. C. Hockey ...	B.A. Eagle (Major) ...	26 41	37 2	124.00	11
17	Flt. Lt. T. Rose...	B.A. Eagle (Major) ...	26 41	35 14	130.25	4
5	J. Bayly	Miles W. Straight (Major)	27 56	34 38	132.50	7
14	G. Marshall ...	Miles W. Straight (Major)	27 56	35 43	128.75	10
1	G. R. de Havilland	T.K.2 (Major)	35 25	26 56	170.50	5
4	A. Henshaw ...	Percival Mew Gull (Gipsy Six R.)	40 20	22 2	208.00	6



Preparing to catapult a Supermarine Walrus amphibian at the R.A.E., Farnborough. This catapult is of the expanding-ram type, without sheaves and wire ropes. (*Flight* photograph.)

Part II. Development of the Catapult : Data on Different Types : The Field Type or "Accelerator" : Future Requirements

ASSISTING the TAKE-OFF

IN addition to the Mayo "Composite Aircraft" scheme dealt with in last week's article, there are two possible methods of assisting the take-off of aircraft. Probably the most promising of these is the catapult principle in some form or other; many variants of this are obviously possible. The other system aims not at getting a heavily loaded aircraft into the air by the aid of extraneous power, but by taking it into the air in a lightly loaded condition and then transferring the bulk of the fuel load to it from another aircraft, which may be termed the "tanker."

At the R.A.F. Display at Hendon in June a demonstration of refuelling in the air was given by a Boulton Paul Overstrand, which was refuelled from a Vickers B.19/27. The demonstration indicated that great improvements have been made during the last year or two, the process of making contact being much more certain and rapid than it used to be, and the automatic coupling with automatic fuel cut-off providing a safeguard as well as greatly facilitating the operation.

Briefly explained, the operation shown at Hendon begins with the aircraft to be refuelled trailing a line about 150ft. long and terminating in a grapnel. The "tanker" lowers about 80ft. of cable with a weight which causes the cable to hang nearly vertical. When the flight paths of the two aircraft cross one another, at different heights, of course, the grapnel catch and contact is established. The "tanker" next lets out the refuelling pipe, with the coupling line attached, and the pipe is brought over by the pull of a drogue attached to the coupling line. Trailing back in the wind, the drogue pulls the coupling line with it, the pipe line being pulled towards the other aircraft until the operator can make the actual connection.

In bumpy weather it is difficult to keep the two aircraft at a given distance and position in relation to one another, and this difficulty gave much trouble in the earlier refuelling tests. Now, however, a special type of automatic pipe coupling is used, which parts as soon as the pull reaches a certain amount. At the same time an automatic cut-off prevents the fuel from escaping. As soon as the two aircraft approach close enough again the drogue restores the union.

It may, perhaps, be said that the technical difficulties of transferring fuel from one aeroplane to another have been solved. The operation is quite quick, the rate of fuel

A Dornier Do.18 (two Junkers Jumo diesels) on the Heinkel catapult on board the mother ship *Ostmark*. This equipment was used for the German transatlantic experiments.

In this picture the Do.18 is seen circling the *Ostmark* after being catapulted off. The latest D.L.H. mother ship *Friesenland* carries a catapult capable of launching aircraft up to 37,000 lb. gross weight.

transfer being some 80 gallons per minute. There would, therefore, be no difficulty in refuelling the Short long-range boat *Caledonia*, for example, at the start of her flight across the North Atlantic. Obviously, the whole of the petrol supply would not be taken on in the air, but a considerable quantity could be added once the machine had left and was on her way. At present this is not necessary, as the boat gets off without difficulty with an ample margin of fuel for the flight, but later, when pay-loads come to be carried, the experiment might well be worth trying.

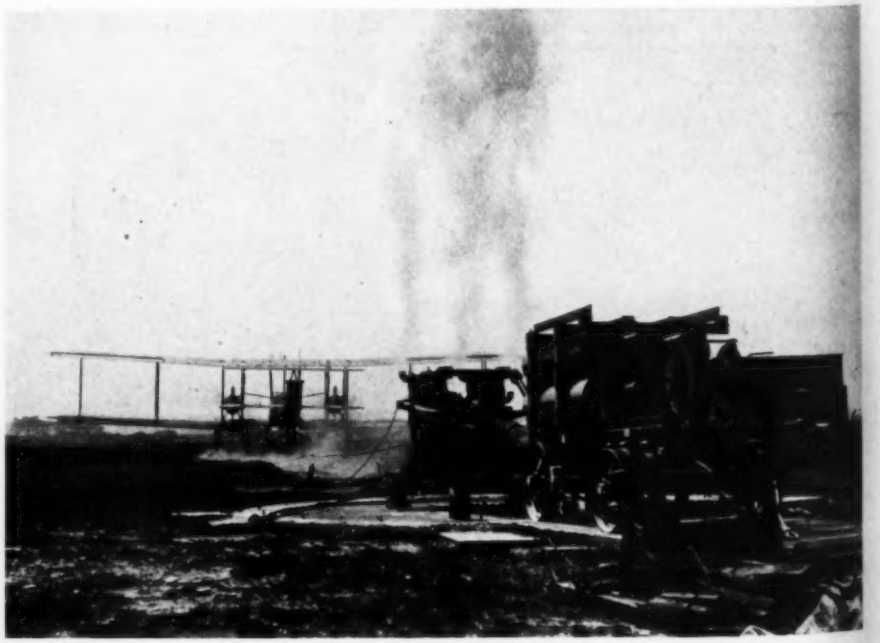
The main obstacle to the general adoption of refuelling in the air for long-range air routes is raised by weather conditions. On a clear day there are no technical or operational difficulties in establishing contact, but in thick weather it is likely that the two aircraft would experience considerable difficulty in locating one another.

Catapult launching seems to offer the most promising line of development, not only from the aircraft point of view, but also, possibly, in connection with getting heavily loaded aircraft out of aerodromes of reasonable size. There are obviously limits to the size which it is economically possible to make aerodromes near cities, and if the use of catapult starting in some form should enable the size of necessary land to be greatly reduced, the cost of the catapult might easily prove worth while. The objection is that an aircraft requires nearly as much space for landing as it does for taking off, particularly if the disposable load has not been appreciably reduced during the flight preceding the arrival. On the shorter air routes the amount of fuel consumed during flight is a fairly small proportion of the total load, and so its effect on landing space requirements is not great.

As mentioned in last week's article, the earliest use of catapults was made in America, where Langley and the Wright brothers adopted it. More correctly, the Wright dropping-weight system should be described as an accelerator for use in a field, as it was not a catapult in the sense the word is used to-day. The power-driven catapult for launching aircraft from ships, where the length of take-off run is necessarily limited, also owes its inception to the United States where, as early as 1912, a successful launch was made from the deck of a coal barge at the Washington Navy Yard. By the end of 1925 the United States Navy had 32 catapults in service on battleships and cruisers. In the early catapults compressed air was used, but in 1924 the first American powder impulse catapult was taken into use. The chief advantage of this was found to be that a larger number of aircraft could be catapulted in a given period, as the time taken in re-charging the compressed air cylinders was saved.

British Beginnings

In Great Britain a beginning was made in 1916, when a specification for a catapult was prepared. This required that the catapult should be capable of launching an aircraft weighing 5,500 lb. at a speed of 60 m.p.h. with an acceleration not exceeding 2½ g. in a run of 60ft. Two catapults, both using compressed air, were completed to this specification, one being built by Armstrong Whitworth and Co. and the other by Waygood-Otis. Then came the end of the war, and it was not until 1922 that catapult work



An accelerated take-off: A Vickers Virginia being launched by the Farnborough field catapult. With this the aeroplane runs along on its own wheels and is air-borne after a run of 120 ft. (*Flight* photograph.)

was resumed. Mr. R. Falkland Carey, who had designed the Waygood-Otis catapult, designed a new one, which followed in a general way the lines of the American catapults, with the motion of the ram transmitted to the launching carriage by wire ropes over pulleys. The Carey catapult was designed to launch aircraft up to 7,000 lb. weight, the run being 34ft. and the speed 45 m.p.h. The mean acceleration was 2 g. Compressed air was used.

Simultaneously with the design of the Carey catapult, the R.A.E., Farnborough, proceeded with the design of an entirely different type. The speed, run and acceleration were the same as for the Carey, but no cables and pulleys were used, the launching carriage being attached directly to the smallest of the series of telescopic tubes which formed the ram. Again compressed air was used as the motive power, the pressure in the bottles being 2,000 lb./sq. in. Two of these catapults were built by MacTaggart Scott.

Cordite Introduced

In 1928 the R.A.E. catapult was modified to use cordite instead of compressed air, and in later developments of it the forward half of the structure is hinged so as to stow alongside the rear half when the catapult is not in use. Larger versions will launch aircraft up to 8,000 lb. weight at 55 m.p.h., the run being 50ft.

In recent times the wire-ropes-over-pulleys type of catapult has come into favour, two Admiralty designs particularly being used extensively by the Navy. One of these was built by MacTaggart Scott and the other by Ransome and Rapier. The latter is known as the "slider" type from the fact that a subsidiary sliding structure is made to move along the main structure, and carries the actual launching carriage, which in turn runs along the sliding structure.

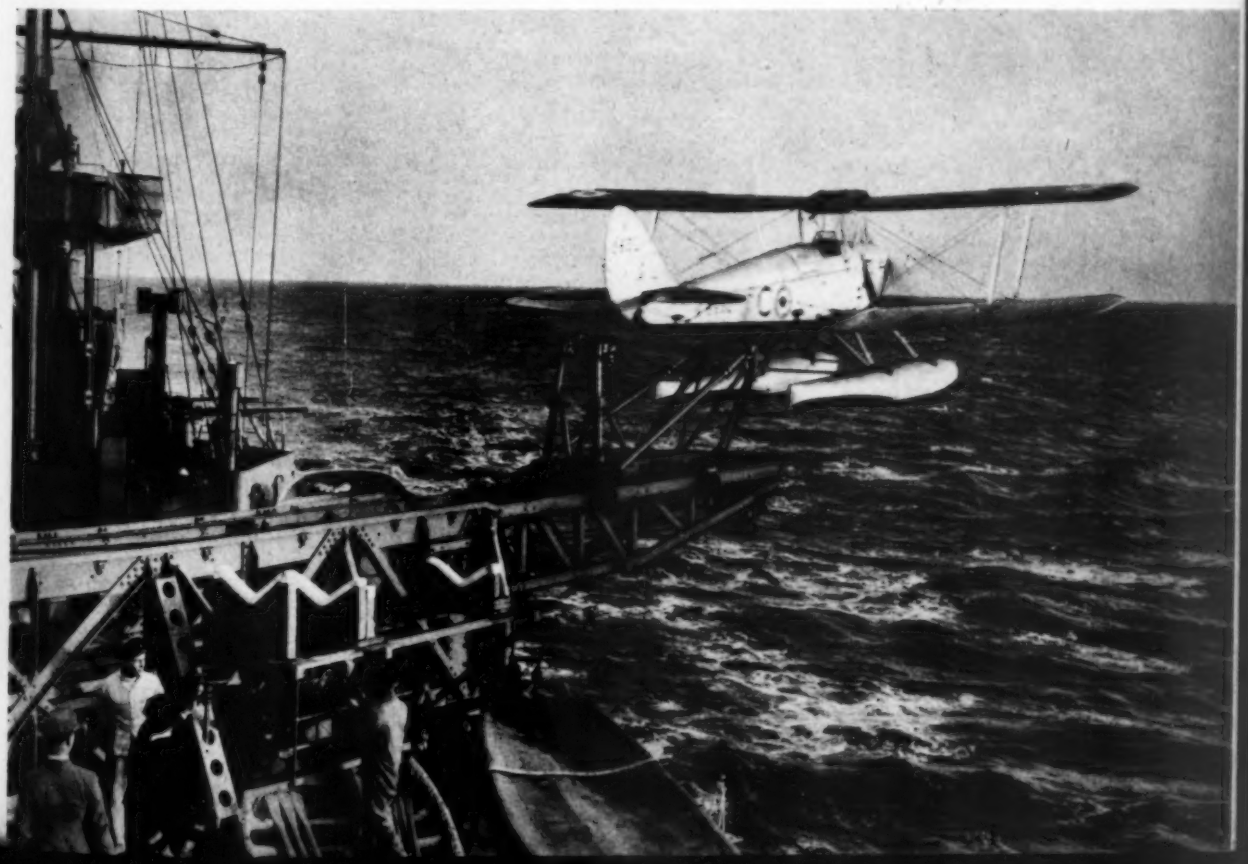
The MacTaggart Scott type has its main structure divided into three portions, the two end portions sliding inside the centre portion for stowage. This catapult will launch aircraft up to 8,000 lb. at a speed of 57 m.p.h., 7,000 lb. at 60 m.p.h., and 6,000 lb. at 63 m.p.h. The corresponding mean accelerations are 2.15 g, 2.38 g, and 2.62 g. The launching run is 50ft. 6in.

In Germany considerable catapult development has taken place, notably by the Heinkel firm, in connection with the "mother ships" used on the South Atlantic air route and, more recently, on the North Atlantic experiments. The most recent of these ships, the *Friesenland*, belonging to the Deutsche Luft Hansa, has a Heinkel catapult capable of launching aircraft up to 37,000 lb. gross weight, which is probably the most powerful catapult hitherto constructed. If, however, catapults of this size can be used successfully on a vessel, there would not appear to be any reason why catapults of even greater power should not be used ashore.

It will usually be found that space is nothing like so cramped on land as on board ship, so that a much longer starting run can be permitted. This means that either the power required can be smaller, or the take-off speed greater, or that the acceleration can be reduced to a much smaller figure. On military aircraft it is usually possible to design the structure to be strong enough to stand an acceleration of 3 g-4 g. It has been found that the crew can stand an acceleration of 5 g without very much discomfort, mainly due to the fact that the acceleration is in a horizontal direction, as distinct from certain aerobatic manœuvres in which the acceleration is usually in a direction parallel with the pilot's spine. In this connection it is interesting to note that experiments have shown that accelerations of 5.2 g sustained for less than 1 second were no more unpleasant than accelerations of 3 g for 1½ seconds.

The "Accelerator" Type

Some years ago the R.A.E. developed a totally different type of catapult, which has been variously described as a field catapult and an accelerator. It is not a catapult in the sense that the aircraft is not secured to a launching carriage but runs along the surface of the aerodrome on its own wheels. In order to reduce the angle of incidence of the wings, the tail is carried on a trolley, which is, of course, arrested when the aircraft leaves the ground under the control of the pilot. The Farnborough accelerator has an interesting power unit, in which two compressed-air engines are used, each developing 2,000 b.h.p. at 2,500 r.p.m. The engines drive, through a 6: 1 gearing, a cable



Mechanisation: A De Havilland Queen Bee wireless-controlled target aeroplane is catapulted, pilotless, from H.M.S. *Neptune*

drum of 4ft. diameter, the cable being led from the drum to a pulley anchored to the aerodrome at a point slightly ahead of that at which the aeroplane leaves the ground and thence back to the aircraft. With this type of accelerator aircraft up to 18,000 lb. weight can be started in a run of 120ft. at a speed of 60 m.p.h. The mean acceleration is only 1 g, which is low enough to be suitable even for passenger aircraft, provided passengers are warned beforehand to rest their heads against the backs of their chairs at the moment of starting.

Compressed air at 1,800 lb./sq. in. is contained in a number of steel cylinders carried on a tender.

Alternative methods of supplying the extraneous power for launching have been suggested. Capt. Frank T. Courtney, for instance, has spent a great deal of time and thought on the subject of shore-based catapults, and he has come to the conclusion that there is no serious objection to using a permanent track, laid in the direction of the prevailing wind, if the carriage on which the aircraft rests is permitted to rotate under the "weathercock stability" of the aircraft itself. In a wind blowing at an angle to the track, the machine would automatically adapt itself to the relative wind, which would vary in direction as the launching carriage gathered speed along the track. At the moment of leaving the carriage the aircraft would be at an angle to the track, but it *would* be facing into the relative wind. As Capt. Courtney contemplates launching speeds in the neighbourhood of 130 m.p.h., the angle caused by a wind of 30 m.p.h. blowing across the track would not be excessively large.

For what may be termed track-launching, obviously a great variety of power units might be suitable. Capt. Courtney suggests, for instance, that a light carriage driven by aero engines via airscrews might be suitable. Or a stationary power supply could be used, the power being transmitted to the launching carriage by an endless cable running over very large pulleys spaced the take-off run apart.

The permanent shore-based catapult or accelerator will obviously present problems not encountered in the case of catapults carried on vessels. For one thing, it is likely that they will have to be designed for launching aircraft of far greater gross weight than any likely to be used in the Navy. For commercial work the ideal site would appear to be an aerodrome adjoining a stretch of sheltered water on which flying boats could alight on arrival from overseas, afterwards being hauled up on to the track for the launch on the next outward flight. The same starting track and power plant should be available for assisting landplanes into the air, so that the same general base would serve for all long-distance air routes.

One hesitates to complicate the issues, already sufficiently difficult, by suggesting further expenditure, but it is quite obvious that it is very necessary to take the long view, and the Empire air base at Portsmouth seems to be the logical site for all material and equipment connected with long-distance commercial flying. Whether it is possible to provide for catapult launching in addition to other facilities in Langstone Harbour is another matter. It is, however, high time that we got our plans going, and they ought to include every foreseeable development likely to take place, so that instead of having to shift from one site to another in a few years time, additions of equipment could be made as and when they were required. Catapult or accelerator launching is very definitely one of the developments likely to be needed before long.

BADGES FOR EIGHT MORE R.A.F. UNITS

A further set of R.A.F. unit badges has been approved by His Majesty the King. Chester Herald's description of the badges, which are reproduced above, is as follows :—

No. 11 Flying Training School: Two dexter hands couped at the wrist holding a winged torch. No. 12 (Bomber) Squadron: A fox's mask. No. 40 (Bomber) Squadron: A broom. No. 41 (Fighter) Squadron: A double-armed cross. No. 74 (Fighter) Squadron: A tiger's face. No. 203 (Flying Boat) Squadron: A winged sea-horse. No. 230 (Flying Boat) Squadron: In front of a palm eradicated a tiger *passant guardant* School of Air Navigation: A star of eight points.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

EXTENSION OF SERVICE

The following detailed instructions are issued regarding the methods of selection for extensions of service of officers of the general duties branch due to transfer to the reserve on or after April 1, 1938:—

(i) *Extension of service of medium service officers.*—Extension of service to complete eleven years on the active list, followed by four years in the reserve, may be granted to medium service officers due to transfer to the reserve on or after April 1, 1938, and prior to April 1, 1939, who volunteer and are recommended therefor. The gratuity in respect of the eleventh year of service will be £100.

(ii) *Extension of service of short service officers to seven years.*—The service of short service officers commissioned on or after April 1, 1932, and prior to April 1, 1933 (and therefore entered for six years' active list followed by four years' reserve service) who volunteer and are recommended, may be extended to seven years on the active list, followed by four years in the reserve. The gratuity in respect of the seventh year of service will be £100.

SPECIALIST A* COURSE—AIR ARMAMENT SCHOOL

The undermentioned officer, having successfully completed an advanced specialist course in armament at the Air Armament School, Eastchurch, is awarded the symbol A*:—Flt. Lt. E. S. D. Drury.

The undermentioned officer also successfully completed the course: Flt. Lt. G. W. Boucher, R.A.A.F.

FLYING ACCIDENTS

The Air Ministry regrets to announce the following accidents:—

Flt. Lt. Eric Rolfe Simonds is missing and believed to have been drowned as the result of an accident which occurred off Felixstowe on July 22, to an aircraft of the Aeroplane and Armament Experimental Establishment, Martlesham Heath. Flt. Lt. Simonds was the pilot and sole occupant of the aircraft.

As the result of an accident which occurred at Chapel-en-le-Frith on July 22, to an aircraft of No. 166 (Bomber) Squadron, Leconfield, Beverley, Yorkshire, the undermentioned personnel lost their lives.—Sergt. Newton William Baker, Sergt. James William Barker, Sergt. Charles Patrick Dugald McMillan, A/C.1 Eric James McDonald, A/C.1 William Henry Gray, A/C.2 Ernest John Musker. Sergts. Baker and McMillan were the first and second pilots of the aircraft.

P/O. Philip Hughes Crompton lost his life in an accident which occurred near Barnsley, Yorks, on July 23, to an aircraft of No. 72 (Fighter) Squadron, Church Fenton, near Tadcaster, Yorks. P/O. Crompton was the pilot and sole occupant of the aircraft.

FOREIGN OFFICER WITH THE R.A.F.

Lt. Lin-Wen-K'Uei of the Chinese Air Force, has been attached to No. 6 Flying Training School, Netheravon, from July 19 to August 7.

TRANSFER TO THE RESERVE

The undermentioned short service, medium service and non-permanent officers should note that they become due in the periods stated for transfer to the reserve, or (where indicated) for relinquishment of commission, on completing their period of service on the active list:—

DECEMBER, 1937—JANUARY, 1938

General Duties Branch

Flt. Lts. Hill Harkness, John Bruce Knapp, Frederick John Taylor, and Esmond John Hugh Fulford Moreton.

Medical Branch

Flt. Lts. Richard Gostwycke James, M.R.C.S., L.R.C.P., *James Wilson Patrick, M.B., B.Ch., D.P.H., Lancelot Miller Corbet, M.B., B.S., Arthur Harold Osmond, M.R.C.S., L.R.C.P.

Dental Branch

Flt. Lt. Alexander Maben, L.D.S.

Chaplains Branch

†The Revd. Alan Stanley Giles, B.A.

†To relinquish commission, not liable for reserve service.

The officer marked * has been provisionally selected for a permanent commission

FOUR HUNDRED BOYS REQUIRED

The Air Ministry announces that approximately 400 Boy Entrants will be required in September for training in the Royal Air Force trades of armourer, photographer, and wireless operator. Candidates must be not less than 15¾ and under 17¼ years of age on September 1, 1937. Entry is by selection from among candidates found to be educationally suitable and medically fit.

Full particulars are contained in A.M. Pamphlet 54, which may be had, free, from the Inspector of Recruiting, Royal Air Force, Victory House, Kingsway, London, W.C.2. Applications should be made on A.M. Form 1391, obtainable from any local education committee or juvenile advisory committee (under the Ministry of Labour) or directly from the Secretary, Air Ministry, Adastral House, Kingsway, London, W.C.2.

ROYAL AIR FORCE GAZETTE

London Gazette, July 20, 1937

General Duties Branch

Flt. Lt. R. W. M. Clark, D.F.C., is granted a permanent commission in that rank (July 18).

The following are granted short service commissions as Acting Pilot Officers on probation with effect from and with seniority of July 5:—W. W. Adam, R. F. Aitken, D. H. Allen, G. D. Angus, G. E. Ball, V. G. Bamber, D. Bamford, H. W. Barnard, R. G. L. Baxter, C. Bellis, T. L. Bingham-Hall, J. Brandt, C. P. N. Brett, G. A. Brown, B. M. Browning, D. C. Bruce, C. Cakebread, D. C. G. Clinkard, D. C. Smith, F. H. P. Connor, J. F. R. Crane, R. E. Craven, E. L. Cullimore, C. D. Curtis, P. S. Davis, T. H. Davison, J. G. Day, I. B. Difford, P. A. L. Farrell, I. G. O. Fenton, V. J. Fenwick, P. G. F. Fletcher, M. F. H. Fox, E. Garrad-Cole, T. J. Gascoigne, P. Gearey, J. A. Gray, P. S. Harvey, M. T. G. Henry, R. D. Hesketh, J. P. M. Hewett, H. J. Holt, R. H. Jacoby, T. H. H. Jones, C. M. P. Kempster, R. B. Lines-Roberts, J. M. Littler, S. H. Lyttle, J. F. Mackie, R. R. McQueen, J. D. Mills, J. G. Minifie, A. D. Morton, T. I. S. Munro, C. O'S. Murphy, T. H. Myers, W. G. New, B. Paterson, D. B. Pearson, C. V. Reade, I. G. Richmond, N. C. S. Riddell, R. E. Ridgway, F. C. Rose, A. G. Salter, P. B. Sentance, W. A. Stenhouse, G. J. Stonhill, F. Strathdee, K. R. H. Sylvester, H. Taylor, J. R. Tobin, E. C. C. Tomkins, M. J. Tully, G. Vivian, J. D. H. Wake, G. B. Walford, R. J. Walker, P. W. Hunt, C. E. Watson, R. J. Wells, P. G. Whitby, B. D. Wigginton, V. T. L. Wood, C. L. Wright.

Flt. Lt. W. S. Reed is seconded for duty under the Iraqi Government (July 6); Pilot Officer on probation J. McLaughlin is confirmed in his appointment (May 21); Acting Pilot Officer on probation N. H. des C. Brouard is graded as Pilot Officer on probation (January 6); Wing Cdr. the Hon. R. A. Cochrane, A.F.C., is granted the acting rank of Group Captain (paid) while seconded for duty with the Government of New Zealand (February 1); Sqn. Ldr. E. P. Mackay is granted the acting rank of Wing Commander (unpaid) while serving as member of the Anglo-Egyptian Treaty Planning Committee (July 1).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—L. B. B. King (June 16); W. G. Bannister (seniority November 28, 1935) (June 30); H. M. Cox (July 6).

The following Flying Officers are promoted to the acting rank of Flight Lieutenant (June 8):—E. A. Howell, E. L. Colbeck-Welch.

The following Pilot Officers are promoted to the rank of Flying Officer (June 14):—J. D. Green, W. Foulsham, M.C.

Lt.-Cdr. H. Wright, R.N., Flying Officer, R.A.F., ceases to be attached to the R.A.F. with effect from May 10 on return to Naval duty and is reattached to the R.A.F. as a Flying Officer with effect from July 3 and with seniority of January 12, 1930; Lt. A. C. Newson, R.M., Flying Officer, R.A.F., ceases to be attached to the R.A.F. on return to duty with the Royal Marines (July 21); Flt. Lt. D. Sloan is transferred to the Reserve, Class A (July 15); F/O. R. B. Middleton is transferred to the Reserve, Class C (March 16) (substituted for notification in *Gazette* of March 16).

Accountant Branch

The following Pilot Officers on probation are confirmed in their

appointments and promoted to the rank of Flying Officer (June 12):—D. W. J. Brown, S. M. Macildowie.

Medical Branch

The commission of F/O. J. H. L. Newnham, M.R.C.S., L.R.C.P., is antedated to July 9, 1936, and he ceases to be seconded to the London Hospital with effect from July 1.

Commissioned Engineer Officers

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from July 7 and with seniority of May 18:—W. R. Frost, H. Myles, A.F.M.

Commissioned Signals Officer

W/O. V. G. Macario is granted a permanent commission as Flying Officer on probation with effect from July 8 and with seniority of May 18.

Erratum

In the *Gazette* of June 22—For Herbert Reginald Richards Tredinnick read Herbert Reginald Tredinnick.

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

The following are granted commissions as Squadron Leaders in Class C on the dates stated:—Sqn. Ldr. H. Dawes, M.B.E. (R.A.F. Retired) (June 21); Sqn. Ldr. B. E. Harrison, A.F.C. (R.A.F. Retired) (July 1).

Col. J. R. Stewart, T.D. (T.A.R.O.), is granted a commission as a Flight Lieutenant in Class C (May 24); D. H. G. Tollemache is granted a commission as Pilot Officer in Class C with effect from June 22 and with seniority of April 6; F/O. M. J. Wyatt, M.C., is granted the honorary rank of Flight Lieutenant (June 1); F/O. D. L. Dustin is transferred from Class C to Class A (June 30); Flt. Lt. (Hon. Sqn. Ldr.) J. V. Read, M.B.E. (Sqn. Ldr., R.A.F. Retired), relinquishes his Reserve commission on completion of service (June 15); F/O. F. T. Digby, D.S.O., D.S.C., relinquishes his commission on completion of service and is permitted to retain the rank of Squadron Leader (October 2, 1936).

The following Flying Officers relinquish their commissions on completion of service on the dates stated:—T. G. Figgis (March 16, 1936); R. Edwards (April 1); R. S. Gleadow (July 1).

Medical Branch

Flt. Lt. J. Twohill, M.B., relinquishes his commission on completion of service and is permitted to retain his rank (July 13).

AUXILIARY AIR FORCE

General Duties Branch

No. 501 (COUNTY OF GLOUCESTER) (BOMBER) SQUADRON.—M. V. M. Clube is granted a commission as Squadron Leader and appointed to the command of the Squadron (July 12).

No. 502 (ULSTER) (BOMBER) SQUADRON.—J. C. G. Bell is granted a commission as Pilot Officer (July 1).

No. 604 (COUNTY OF MIDDLESEX) (FIGHTER) SQUADRON.—The following are granted commissions as Pilot Officers on the dates stated:—R. H. Scott (April 10); A. S. Hunter (April 17).

F/O. R. A. Budd is promoted to the rank of Flight Lieutenant (December 9, 1936).

No. 605 (COUNTY OF WARWICK) (BOMBER) SQUADRON.—Flt. Lt. D. L. Lloyd relinquishes his commission (June 30).

No. 611 (WEST LANCASHIRE) (BOMBER) SQUADRON.—J. W. Carmichael is granted a commission as Flying Officer (June 7).

Medical Branch

F/O. I. A. G. L. Dick, M.D., F.R.C.S., is promoted to the rank of Flight Lieutenant (June 15).

AUXILIARY AIR FORCE RESERVE OF OFFICERS

General Duties Branch

D. L. Lloyd is granted a commission as Flight Lieutenant in Class A (June 30).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commander.—A. S. Thompson, to Home Aircraft Depot, Henlow; to command No. 2 R.A.F. Depot, 1.7.37.

Squadron Leaders.—G. C. Stemp, to No. 1 Armament Training Camp, Catfoss; for Armament duties, 3.7.37. W. H. Poole, A.F.C., M.M., to Headquarters, No. 5 (Bomber) Group, Mildenhall; for Air Staff duties, 1.7.37. R. M. Davy, to Headquarters, Coastal Command, Lee-on-the-Solent; for Personnel Staff duties, 3.7.37. B. H. Vasse, to R.A.F. Station, Northolt; for Armament duties, 5.7.37. W. E. James, to School of Naval Co-operation, Lee-on-the-Solent; for duty as Adjutant, 8.7.37. R. J. A. Ford, to No. 211 (Bomber) Squadron, Mildenhall; to command, 5.7.37.

Flight Lieutenants.—B. A. J. Crummy, to Directorate Technical Development Dept., Air Ministry, 3.7.37. G. E. Macdonald, to R.A.F. College, Cranwell, 3.7.37. G. P. Macdonald, to No. 1 Flying Training School, Leuchars, 3.7.37. M. H. Dwyer, to No. 5 Flying Training School, Sealand, 3.7.37. H. R. Allen, to No. 7 Flying Training School, Peterborough, 3.7.37. H. W. Dean, to Air Observers School, North Coates Fitties, 3.7.37. C. F. S. Fraser, to No. 2 Armament Training Camp, Aldergrove, 3.7.37. A. Golding and C. R. D. L. Lloyd, to No. 3 Armament Training Camp, Sutton Bridge, 3.7.37. W. R. Brotherhood and L. Coulson, to No. 4 Armament Training Camp, West Freugh, 3.7.37. A. McD. Bowman and J. M. Warfield, to No. 5 Armament Training Camp, Penrhos, 3.7.37. E. B. C. Davies, to No. 6 Armament Training Camp, Woodsford, 3.7.37. E. G. Granville, to Armament Training Camp, North Coates Fitties, 3.7.37. R. A. R. Rae, to R.A.F. Depot, Uxbridge, 2.7.37. S. P. A. Patmore, to R.A.F. Depot, Uxbridge, 4.7.37. J. T. Mynors, to Directorate of Technical Development, Air Ministry, 12.7.37. E. M. F. Grundy and L. Crocker, to Special Duty List, whilst on interchange duty with the Royal New Zealand Air Force, 11.6.37. K. A. K. MacEwen, to Superintendent of the Reserve, Hendon, 5.7.37. I. C. Bird, to Headquarters, Bomber Command, Uxbridge, 1.7.37. W. S. Reed, to Special Duty List, whilst seconded for duty as Assistant Inspector, Iraqi Air Force, 6.7.37. E. A. Springall, to Station Flight, Abingdon, 6.7.37.

Flying Officers.—R. G. Seys, D.F.C., to No. 218 (Bomber) Squadron, Upper Heyford, 13.7.37. P. D. W. Hackford, to R.A.F. Station, Gosport, 1.7.37.

Pilot Officers.—D. Greville Bell, to No. 13 (Army Co-operation) Squadron, Odiham, 28.6.37. G. B. Andrews, to No. 6 Armament Training School, Woodsford, 2.7.37.

Acting Pilot Officers.—G. A. Thompson, to No. 3 Flying Training School, Grantham, 27.6.37. J. L. Ellis, to No. 6 Flying Training School, Netheravon, 28.6.37. P. R. Barr, to No. 8 Flying Training School, Montrose, 17.6.37.

Equipment Branch

Flying Officer.—W. H. Dyson, to No. 4 Equipment Depot, Ruislip, 8.7.37.

Accountant Branch

Flight Lieutenant.—A. E. West, to R.A.F. Station, Cardington, 19.7.37.

Medical Branch

Squadron Leader.—F. D. Barling, to No. 3 Flying Training School, Grantham; for duty as Medical Officer, 14.7.37.

Flight Lieutenants.—T. D. L. Bolan, to R.A.F. Station, Feltwell, 10.7.37. J. F. Dales, to R.A.F. Station, Finningley, 12.7.37. D. J. Sheehan, to Central Medical Establishment, London, 14.7.37.

Dental Branch

Flight Lieutenant.—A. Maben, to R.A.F. Station, Cardington, 15.7.37.

CONTRACT PRICES DISCUSSED AT H. P. MEETING

AT the Handley Page annual general meeting, held last week in London, Mr. S. R. Worley (the chairman) said that their turnover for the year under review had been very much larger than in the previous year and their works had been engaged on the completion of the contract for the Heyford, and during the latter part of the year on the contract for the production of machines of the Harrow type. They had substantial orders for those and also for the production of their other type, the Hampden, the manufacture of which would proceed concurrently with the latter part of the Harrow contract and thereafter would be in full production. In addition to their production work, they had a corresponding heavy programme of new types which they were constructing for the Air Ministry, from whom they anticipated production orders.

With regard to prices, the prevailing system seemed to be that contractors received instructions to proceed on contracts with, in some cases, a provisional price fixed for the contract, and the question of the ultimate determination of the contract price was left over for settlement at a later date. On the face of it that seemed to secure that excessive profit was not made, but on the other hand it was an essentially inefficient method of operation, in that there was not the same incentive for efficient working and economy as in a fixed-price contract. They had pressed for a fixed-price settlement on their main contracts and had recently reached agreement in regard to their contract price for the main contract now under execution.

They claimed that their costs of production compared most favourably with those of any other contractors. He was glad to say that they ranked among the relatively few contractors who had not only been able to adhere to, but had also been able to exceed, the contract programme of deliveries.

Mr. F. Handley Page (managing director), commenting on compensation to be payable, after the expansion scheme, in respect of extensions of plant, said that their own aim had been to increase output rather by greatly increased efficiency of production than by extensions to the works. With regard to civil aircraft development, they were not neglecting to devote a proportion of their time to research and development.

PRIVATE FLYING

Topics of the Day

Primitivity

CAN you tell me why, after buying or hiring a £1,000 aeroplane, it should still be necessary to perform 1909 motoring antics before taxying out for the take-off?

First you enter the cabin (sometimes sitting on your hat after emulating the muscular movement of a climber scaling the Pinnacle Rock) to see that the brakes are hard on, the switches off and the throttle very slightly open; then you walk round the wing, lift the cowling and, balancing this oily slab of cold metal on the top of the head, you work a mechanical pump lever while holding the end of the piece of wire which keeps the carburettor float inoperative; wiping oily hands on the seat of your pants, you then proceed to turn the airscrew round a few times, afterwards walking round the wing again to switch on; then, at last, you apply real energy to the airscrew.

The engine may start. Sometimes it doesn't, and in that case you tap the inertia magneto and try again, or, more likely, go through the entire process again. By this time the engine is probably saturated with petrol and ten minutes are spent dutifully blowing it all out before attacking the routine for a third time.

Not to be too pessimistic, I may say that engines usually start at the first or second pull.

More Odious Comparisons

NEVERTHELESS, I cannot for the life of me see why it should be necessary to go through this fearful and primitive course of action.

The immediate reasons are obvious. Electric starters are expensive and comparatively heavy; even if one is fitted it is still necessary to flood the carburettor and advisable to turn the engine round a few times before pressing the button if the battery charge is to be conserved. The average light aeroplane engine is not fitted with a built-in generator or an effective priming device, and windmill-driven generators are both ugly and aerodynamically offensive.

Among less immediate reasons are those that very few private owners or clubs appear to demand equipment on such a scale, that payload is necessarily cut down a little to accommodate it, and that light aeroplanes are still being built to a large extent on hand-made one-at-a-time lines. I can find no possible excuse for the lack of an effective priming device which is arranged so that it can be operated either from the cabin or while standing beside the cowling.

I know that this particular comparison is very odious and very ancient indeed; but the owner of a car costing £100 would be very annoyed if he found that he, or his garage attendant, was expected to lift the bonnet, flood the carburettor *and* use the starting handle before setting out on or continuing a normal journey. He would also be very annoyed if he found some of his instruments hung on little platforms of their own all round the driving compartment; if the hand-brake lever came off in his hand; or if the car's upholstery and fittings were in any way shoddy. In expensive aeroplanes we put up with that sort of thing, and worse.

The curious fact that the expensive, hand-made article is often inferior to the cheap, mass-produced article appears to apply both in the aeroplane and car worlds. One or two people I know who have purchased exclusive and expensive chariots have had far more mechanical and other trouble than I have with one of fifty thousand identical vehicles all stamped out of a length of tin. The point being, of course, that if the mass-production designer makes a bloomer there are fifty thousand cars in for replacement, and the firm either goes bankrupt or can at the best look forward to a few lean years while the public regains its confidence.

Not So Bad

MORE than once recently I have rediscovered the curious facts that weather is never quite as bad once you are in the air as it is when viewed from the ground; and that the appalling-looking black mess in front is really not so impossible when you get to it. One's range of visibility in heavy rain, for instance, is a good deal better from an aeroplane than might be expected, and it is only in the heaviest of thunder showers that rain can be really troublesome. My special horror is poor visibility under a low ceiling.

None of which is to suggest that we should rush straight into the air whatever the weather, or rush with one's aeroplane straight into a forbidding curtain which is lying across one's course. When in doubt, don't, but it is certainly possible to overdo the caution business to the extent of failing to get anywhere. The experienced pilot has learnt in a hard and slightly dangerous manner exactly what can and cannot safely be done, and I fear that experience is the only teacher unless one is lucky enough to suffer almost impossible conditions on one's early dual cross-countries.

I was lucky, or unlucky, in doing these over two North Country areas which are almost invariably smoke-bound. Though I gradually learnt to recognise the shape of all the fields in the vicinity of one particular aerodrome, certain mildly harrowing experiences (such as being "lost" within a mile or two of it) probably made me unreasonably cautious, and perhaps saved me from the catastrophic results of over-confidence.

INDICATOR.

Private Flying

FROM the CLUBS and SCHOOLS

News of the Week

GRAVESEND

TEN members of the C.A.S.C. attended at Fen Ditton aerodrome on Sunday, July 18, flying 6 hours, but the annual holidays are a great counter-attraction.

REDHILL

Flying times for the week ended July 23 amounted to 56 hr. 40 min. One of the Puss Moths, flown by Mr. R. Beere, has gone to Exeter, and the other, flown by Mr. A. J. Mulder, to Le Touquet.

CAMBRIDGE

Cross-countries have been made to Brighton, Leicester, Bristol and Liverpool, and one member flew to Paris for the week-end. The flying times for the week were 84 hr. 35 min.

STRATHTAY

Mrs. Ella Watson, of Dundee, made a first solo flight and Messrs. Byars and Carmichael joined as pilot members. A flying total of 30 hours was recorded for the week ended July 19.

SOUTH COAST

Heavy gales and bad weather brought the flying times down to 35 hours, but Messrs. Gordon and Head braved a flight to Cambridge. Mr. W. C. Fox has completed "A" licence tests and there is an influx of new members.

MIDLAND

Dual to the extent of 27 hr. 35 min. and solos totalling 19 hr. 30 min. were carried out last week, together with cross-countries to various Midland aerodromes and into Wales. Mr. D. H. Gittins has joined as a flying member.

NORFOLK

Despite the strong winds, heavy rain and damp grey mist cross-country flights have been made to Hatfield, Southend and Rochester. Members are reminded that the annual general meeting will be held at the Club on Friday evening, July 30.

LONDON

The flying time for last week was 144 hr. 20 min. Messrs. H. J. Aldington, R. D'Abo, P. K. Crowther and H. Howard made their first solo flights, and Mr. C. B. Anderson completed the tests for his "A" licence. New members are Miss Holmes, L. H. Barker, D. H. Balfour, A. B. Pilgrim, J. Keegan and D. Blackburne.

YAPTON

Two days flying was held up by the high winds, 35 hours representing the rest of the week. Mr. Swift Coleman passed his general flying tests at Hendon and technical examinations at Croydon for the "B" licence. Messrs. Dadswell, L. G. Hamlet, John Prentice and L. Brightwell have obtained their "A" licences.

BENGAL

Even in Bengal the weather is a bad handicap for flying. Monsoons prevented flying for two weeks, but 41 hours were logged during June. The secretary—Mr. H. I. Matthews—left for England on leave on June 17, and Mr. N. Innes is officiating in his stead. The membership of the Club has now reached 235.

BROOKLANDS

The proposed flight to Paris has been cancelled, and the Brooklands Flying Club will be open all August Bank Holiday as usual. High winds caused a drop in the flying times, although 92 hours were recorded. New members were Messrs. Bingham, Bamberger and Axlered. Messrs. Cooper, Ireland and Kastelis made successful first solos.

SOUTHEND

Southend Flying Club are very proud of their Leopard Moth recently acquired for the members' use. Dances are being held in the clubhouse on Saturday, July 31, and Monday, August 2, and a welcome is extended to all. Despite bad weather reports elsewhere, average flying times were maintained and Mr. A. Alexander made his first solo.

HANWORTH

Congratulations are due to Mrs. B. Kirby-Green on winner her £100 wager and flying to Paris and back, in adverse weather conditions within two weeks of going solo. Mr. A. Zweigbergk has successfully taken his "B" licence cross-country tests, and Messrs. Holloway and Yeoman have obtained their "A" licences. A total of over 115 hours flying for the week ended July 24 was logged.

YORKSHIRE

Cross-country flights to Doncaster, Brooklands, Belfast, Lympne, Ayr, and so on contributed largely to the 61 hr. 25 min. flying time. Mr. Barrett made a first solo.

CINQUE PORTS

In spite of two days low cloud and rain the members put in 96 hours' flying, dual and solo. On Friday a flight was made to Marseilles by Mr. C. Weir, and four other members flew to Amsterdam. The club was also represented at Le Touquet Rally by Messrs. Duport and Fellows. A successful first solo was made by Mr. Partridge, and Mr. Leigh passed his "A" licence tests.

BORDER

A large new hangar is now completed and in use, and notice of increased facilities is brought to visiting pilots in view of the ample hangarage now available. Mr. Lightfoot flew to Liverpool and back in the Hornet for the purpose of losing a little money at the races there. He also attempted to fly to Cheltenham on Friday, but after 2½ hours' flying in heavy rain and conditions of no visibility he was forced to return to Carlisle in a very wet state. Next day another attempt was successful, the flight taking 2 hr. 20 min. A first solo flight was made by Mr. Kekwick.

KARACHI

The less favourable weather conditions usually experienced at this time of the year resulted in a drop in the total flying time in June to 191 hours, and of this only 38 hours represented cross-country flights, which were necessarily confined mainly to those to Hyderabad and other landing grounds in Sind at not too great a distance from Karachi. During the month Messrs. Mendies, Modak and Pollard qualified for their "A" licences, while eight members are training for "B" licences.

RAND

The Sir Abe Bailey Committee is prepared to grant to the Rand Flying Club the sum of £5 towards the renewal of each "A" licence current at May 14, 1937. Mr. O. Bartmann has been appointed instructor and started work on June 19. Delivery of a Gipsy III Moth is expected. At the invitation of the Johannesburg Light Plane Club five machines took part in a Dawn Patrol on June 27 and a return visit is being arranged. Messrs. M. O'Donovan and G. Oosthuizen made their first solos. The adverse weather conditions and shortage of aircraft machines lowered the flying hours for June, which amounted to 224 hours.

Three-score Years and Spin

CONGRATULATIONS to that irrepressible youngster, Douglas Fawcett, who, at the age of 71, has passed the Heston aerobatics course, by way of a change from flying single-engined aeroplanes over and among the Alps. He has recently purchased a Hornet Moth.

Heston Extension

AN extension to the Heston Airport Club premises has recently been completed, this consisting of a new lounge bar situated just opposite the school entrance. During the past year an additional facility has become available at Heston with the opening of a hairdressing establishment.

A Shooting Party

THE Royal Artillery Flying Club will hold its first flying meeting at its headquarters—High Post Aerodrome, Salisbury—on Saturday, August 21, when there will be various flying competitions for members. Visiting pilots are cordially invited and will be entertained to tea. Events commence at 2 o'clock but visitors arriving earlier can obtain lunch at the aerodrome hotel. The Royal Artillery Band will play during the afternoon.

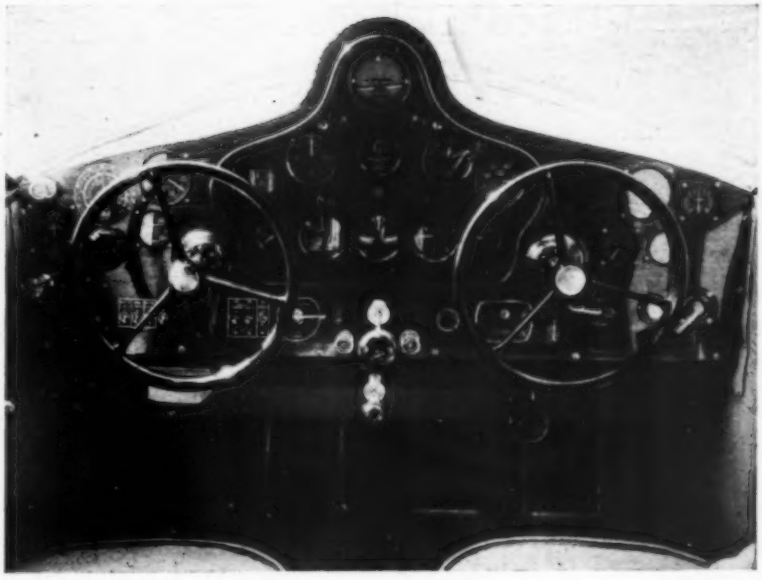
The Second Eastbourne At Home

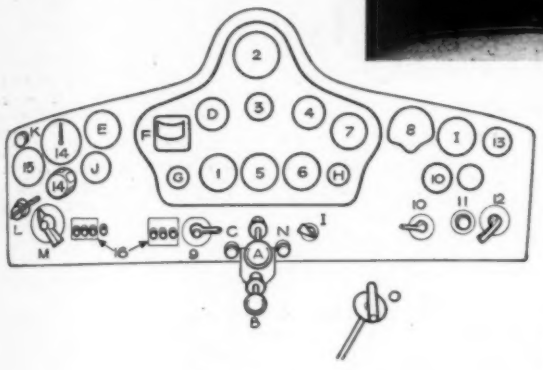
ON August 14 the Eastbourne Flying Club will be holding its second "At Home." There will be a Concours for open and closed machines with two first prizes to the value of £10 10s., an arrival competition between 1.30 and 2.30 p.m., and a long-distance prize, successful pilots in each of the latter being awarded further £10 10s. prizes.

Replies have already been received to invitations sent to Germany, France and Holland, and there is some hope that R.A.F. support will be forthcoming. Last year there were fifty-three visiting machines.

THIS IS EQUIPMENT: By way of showing what can be done in the way of instrument layout with a very fully equipped machine, this photograph of the dashboard of Mr. Leslie Irvin's new Stinson Reliant is interesting. The placings of the instruments and controls are shown in the key below, those applying to the engine operation being indicated by letters and the others by figures. The machine is dealt with in the paragraph below.

(A) throttle; (B) constant-speed airscrew control; (C) mixture control; (D) R.P.M. indicator; (E) manifold pressure gauge; (F) exhaust analyser for mixture test; (G) oil pressure gauge; (H) oil temperature gauge; (I) temperature gauge for cylinder heads and bases, with switch; (J) carburetter temperature gauge; (K) oil cooler control; (L) primer; (M) engine switch; (N) manifold heater control; (O) cabin and carburetter heater control. (1) A.S.I.; (2) artificial horizon; (3) directional gyro; (4) sensitive altimeter; (5) turn and bank indicator; (6) rate-of-climb indicator; (7) air temperature indicator; (8) clock; (9) flap control; (10) vacuum gauge and test switch; (11) vacuum regulator; (12) venturi pump switch-over; (13) ammeter; (14) radio tuning dial and control; (15) homing indicator.





Another Super-Reliant

THERE appears to be something about the Stinson Reliant which encourages owners to develop equipmentitis. Some of the reasons for this seem to be fairly obvious. There is power to spare, and plenty of room on the dash and elsewhere for all the devices which the heart of the enthusiastic pilot could desire.

The penultimate arrival in this country should by now have left Brian Allen Aviation and be in the hands of its owner, Mr. Leslie Irvin, who is very much a Reliant enthusiast. Not only is this machine fitted with a complete range of navigation instruments—all of which are enumerated in the key to the picture on this page—but also with receiving radio and a homing loop, special engine instruments and, last but not least, a constant-speed airscrew.

A half-hour trip in this Reliant showed that instrument multiplicity, provided that the grouping is well and spaciously arranged, need not be a worry, and that the operation of a constant-speed airscrew need not demand the assistance of an engineer with a water-cooled slide rule. With a little experience and the use of an exhaust gas analyser it is possible to cruise at any convenient height with the maximum fuel economy for different circumstances. Once clear of the ground, the Reliant flies itself very nicely indeed, and one's hands are free to attend to all the little matters which add to the interest in cross-country flying.

Professional Parachuting

TO judge by the number of enquiries which *Flight* receives by post and telephone, any number of people, of both sexes, are under the impression that there is plenty of "easy money" in professional parachute jumping. They say: "I know I have the nerve. Please tell me where I can make a test, and how to get a parachuting job."

Actually, it is not nearly so simple as that. In the first place, the position at the moment is that there are rather too many professional 'chutists for the comparatively few jobs available, and, on the whole, they are underpaid for demonstrations which may easily end in a broken ankle and so leave them *hors de combat* for at least three months of the season.

To obtain a licence to jump, the aspirant must conform to the Air Ministry's requirement that ten practice descents be made under supervision. Medical certificates of fitness must be produced and a Ground Engineer's X Category licence for parachute packing must be obtained.

Taking representative figures supplied by a well-known firm, the G.Q. Parachute Co., of Woking, Surrey, instruction for the ground licence, if instructors are available, will normally take five or six days. The hire of a parachute pack, of slightly larger diameter than usual, for the practice jumps would be 25s. per jump; to this must be added the hire fee for an aeroplane to jump from.

The cost of a demonstration parachute is £50 or the hire-purchase equivalent and it is considered almost essential for a jumper to have his own pack. A sum of £100 is really required to cover adequately the costs of instruction and equipment.

In Memory of an Instructor

MANY members of the Scottish Flying Club have expressed a desire to commemorate the services of their late chief instructor—Mr. John C. Houston—to aviation in general and the Club in particular. This, the committee feels, can best be done by establishing a substantial trust fund to be administered for the benefit of his only child, Margaret. Contributions are invited and should be addressed either to the President, Lord Weir of Eastwood, or to Mr. Oliver Cochran, The Scottish Flying Club, Ltd., Renfrew, who is acting as honorary treasurer of the fund.

Glider Towing

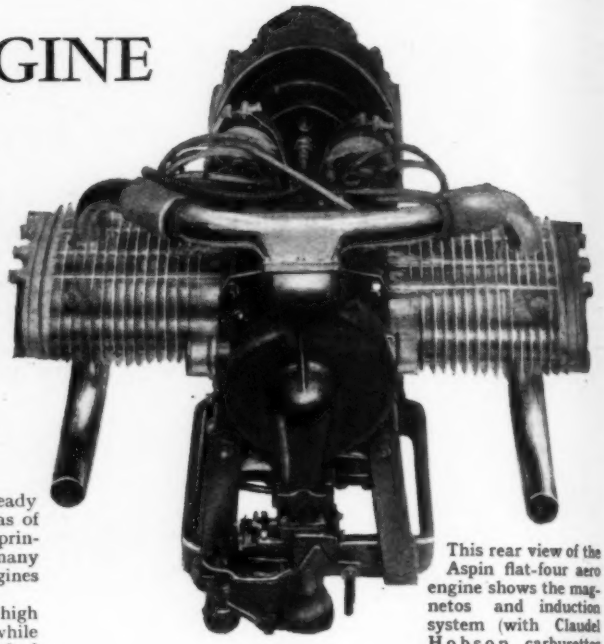
THE Airwork service department has recently developed an improved form of glider towing equipment for use with light aircraft and this has received full Air Ministry approval.

The old method, involving the use of a heavy pylon on the top of the fuselage is now entirely superseded, its place being taken by a neat boom attached to the rear of the fuselage in an aerodynamically correct position. The equipment, which weighs only 10 lb., is quickly detachable and can be replaced without mutilation to the machine. The quick release hook, controlled from the cockpit of the machine, is positive and instantaneous in action, and operation and maintenance are very simple. It is very interesting to note that the run required by an aircraft thus equipped, when taking off with a glider in tow, is apparently the same as for a normal take-off.

This equipment was used before and during the Wasserkuppe meeting.

THE ASPIN ENGINE in DETAIL

Full Description of an Unconventional Flat-four Aero Unit for Which Remarkable Performance Figures are Claimed



This rear view of the Aspin flat-four aero engine shows the magnetos and induction system (with Claudel Hobson carburettor and a mixing fan).

DETAILS of the Aspin engine which have already appeared in *Flight* have indicated that this unit was of more than passing interest, and that it embodied principles of construction which appeared to overcome many of the difficulties associated with internal combustion engines as at present accepted.

The claims made for the engine suggested that very high volumetric and thermal efficiencies had been attained, while mechanical efficiency and reliability appeared to be vouched for by the fact that exceedingly high rates of revolution were possible, and, indeed, were a feature of the normal performance.

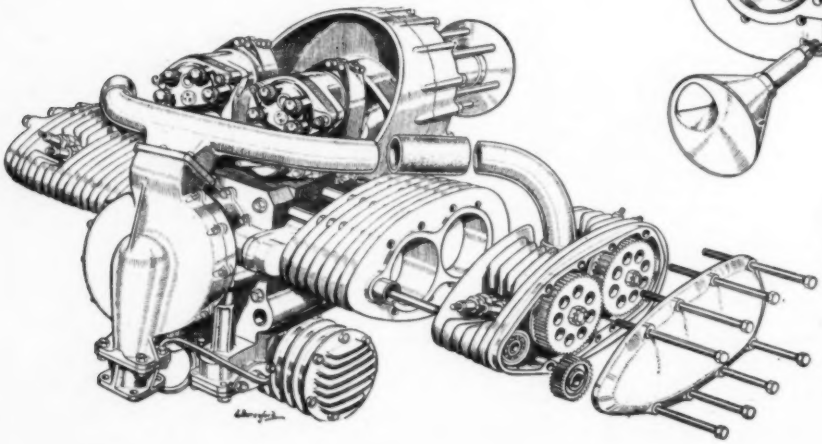
In deference to the wishes of F. M. Aspin, Ltd., Egyptian Mills, Elton, Bury, Lancs, no more than brief general remarks on the performance and some external photographs were published. At the same time, a *Flight* representative has been allowed to study the drawings and the components of test and experimental engines as development proceeded, and the conclusion was reached that the somewhat startling claims were by no means exaggerated, and that the Aspin engine did in fact break new ground. Moreover, it did not appear to be in the freak category, but was evolved on sound and logical lines.

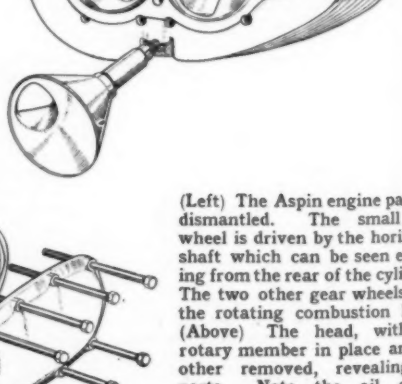
It is now possible to give a full description of the aero engine, together with detail drawings which reveal not only the unusual design, but the remarkable simplicity of construction.

At first glance it might be said to be a rotary-valve engine, but this would not be by any means an adequate description, for the rotary valve arrangement is rather incidental to the use of a *rotary combustion chamber*, upon which most of the thermal efficiency hinges. This rotary combustion chamber is in the form of a cup or cell set eccentrically in a cone, the base of which is the top of the cylinder. The cone is rotated by gearing and a port in its side sweeps over the inlet and exhaust ports in the cylinder head, putting them in communication with the combustion chamber. The sparking plug is fitted into the cylinder head, and therefore is not directly in connection with the combustion chamber except when the port in the cone is opposite the plug hole. Here, again, is a key feature of the engine. One of the claims made was that even with compression ratios of the order of 10 to 1 and higher the engine would run indefinitely at 8,000 r.p.m. on a "pot" insulator touring plug, and this masking of the plug from the combustion chamber, except at the moment of ignition, provides the explanation.

So much for the general arrangement of the cylinder head. Mechanical efficiency and reliability are factors largely dependent upon the arrangement above described; there are no heavy spring loads to deal with, nor have the reciprocating masses of poppet valves to be considered. The rotary chamber is merely an addition to "flywheel weight" and calls for very little power to drive, since the cone is carried by roller bearings and does not make frictional contact with the cylinder head.

Thermal efficiency depends upon the shape and location of





(Left) The Aspin engine partially dismantled. The small gear wheel is driven by the horizontal shaft which can be seen emerging from the rear of the cylinders. The two other gear wheels drive the rotating combustion heads. (Above) The head, with one rotary member in place and the other removed, revealing the ports. Note the oil groove running up the conical face.

the combustion cell in relation to the piston crown, and to the control of turbulence thereby obtained. The piston top is conical and at top dead centre is practically in contact with the base of the rotating cone in the head.

Rotation of the combustion chamber, in conjunction with the shape of the cylinder head passages and of the cell itself induces a very marked swirl of the induced gas, which is maintained throughout the compression stroke, but as the piston reaches the top another factor arises. There is no free space between the piston and the base of the combustion chamber cone, so that the whole of the gas has to be compressed into the combustion cell, the location of which (in relation to the axis of the bore) and the contour of its boundaries control a new and violent turbulence which cuts across the swirl already existing. At the same time the cell port opens the passage to the plug, ignition takes place and combustion in this highly turbulent cell is rapid and complete.

Most of the power stroke is a pure expansion stroke, since combustion is complete a few degrees after top dead centre. That it is complete is borne out by the fact which has previously been referred to in *Flight*, namely, that the hand could, without discomfort, be passed backwards and forwards across the open exhaust port of an engine running at full load at 5,000 r.p.m.; in short, the engine has a "cold" exhaust.

Due to the extreme turbulence within the cell during combustion, and the completeness of combustion therein before the expansion stroke begins, the knock-producing condition associated with "flame front" does not exist, and the engine can be loaded to the stalling point without pre-ignition or knocking. In this respect it has much in common with the diesel engine.

In mechanical design the engine is simple and straightforward. A flat four has been adopted, since it is conducive to a short, stiff structure and in particular to a simple crankshaft; it also has advantages in the matter of frontal area, particularly when considered in relation to the possibility of incorporation in the wing structure.

A short two-throw crankshaft is used with 2-in. journals and big-ends; it runs in roller bearings and, as these are only 8 in. apart no intermediate bearings are called for. Two pistons and connecting rods are opposed on each crank throw and the firing order is directly from front to back, but alternating from side to side, 1, 2, 3, 4.

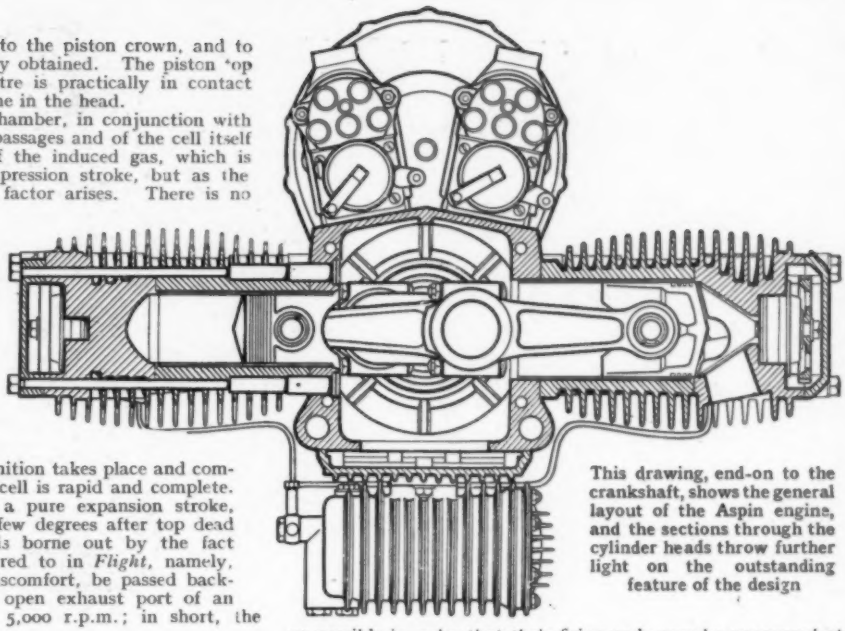
Pistons of the full-skirted type with independent gudgeon-pin boss supporting webs are used. The connecting rods are heat-treated drop forgings of Ceralumin. Light alloy is used for the crankcase.

The Cylinders

Cast in pairs, the cylinders are of aluminium alloy with cast-iron liners; they are provided with deep and widely spaced cooling fins of streamline form. The heads are of similar shape and material, and are rather deep to accommodate the rotary combustion chambers. These are hollow cones of nickel-chrome steel terminating at the apex in a short spindle to pass through the roller races which carry them. Light alloy is used to fill the cone, and it is screwed and shrunk in at the same time, being finally pinned for security; the combustion cell is formed in this composite assembly.

Two taper roller bearings carry the cone in the cylinder head, the lower one taking the compression and explosion thrust and the upper one the weight of the cone. Each cone spindle has a gear wheel mounted above the bearings, and these wheels mesh with each other so that the combustion chambers of the two cylinders in each block run in opposite directions. Transverse shafts across the back of the crankcase, driven by bevel gearing from the crankshaft, terminate in gear wheels which mesh with the rearmost wheel on each cylinder head; the combustion chambers run at half engine speed. Smooth covers enclose the gears on the cylinder heads, and the whole cylinder assembly is held down by long bolts which engage with threaded thimbles inserted in the crankcase from the inside.

Inlet and exhaust ports are on opposite sides of the cylinder blocks, the inlet port being common with a branch to both chambers, while the exhausts are separate; two sparking plugs per cylinder are fitted, and these have to be as close together as possible in order that their firing ends may be uncovered at the same time by the port in the rotating chamber.



This drawing, end-on to the crankshaft, shows the general layout of the Aspin engine, and the sections through the cylinder heads throw further light on the outstanding feature of the design

The twin B.T.H. magnetos, one having an impulse starter, are mounted side by side on the top of the crankcase, and they are driven by gearing from the tail of the airscrew shaft, the 2:1 reduction gear for which is housed in an extension of the casting of the front half of the crankcase. At the rear of the crankcase there is a separate housing bolted on to accommodate the bevel drives for the transverse shafts to the heads and the vertical shafts for the oil pumps. Integral with this housing is the back of a fan casing, a fan-type impeller being mounted upon an extension of the crankshaft, this being a mixing fan for the induction system. The Claudel Hobson carburettor is fitted below the fan housing, while the outlet is coupled to an inlet pipe bridging the two cylinder blocks.

Lubrication

Lubrication is of the dry sump type, embodying a Tecalemit filter, and with a two-gallon oil tank as the recommended equipment. Leads are taken from the oil cooler to the head of each cylinder block to maintain the oil bath in which the gears run, and also to lubricate the conical rotary combustion chambers. These cones run in the heads with an infinitesimal clearance, being assembled tight and run until the surfaces glaze and polish. However, since they must be compression-tight an oil seal must be maintained, and oil is fed to a groove adjacent to the edge of one of the ports so that the supply is constant and the cone is virtually floated on an oil film. An additional aid to the holding of compression is that the outer rim of the cone takes the form of a flexible lip of very thin metal.

Lubrication of this part is not a very serious problem, since it follows that, although *any* combustion chamber is subject to unequal heating and distortion, the rotary arrangement, by bringing the relatively cool parts opposite the hot parts, and vice versa, continuously distributes the head and its effects much more evenly than is otherwise possible.

The makers' data on the engine will indicate its claims to attention for an aircraft requiring a power unit of 60-80 b.h.p.: Bore, 83 mm.; stroke, 80 mm. (1,731 c.c.); output at normal crankshaft speed, 4,800-5,000 r.p.m., 80 b.h.p.; weight, 130 lb. (plus or minus 5 lb.), complete as described with two magnetos, reduction gear, oil filter, etc., but less exhaust stubs and airscrew boss.

The compression ratio is 10.2 to 1 and the consumption is in the region of 0.3 to 0.32 lb. per b.h.p./hour, a most remarkable figure, but one which is not apparently all that can be done in this direction, as the small single-cylinder engine already mentioned in *Flight* has recently returned test figures of less than 0.3 lb. per b.h.p./hour!

The first Aspin aero engine will shortly be subjected to a 100 hours full-load test, and *Flight* has been invited to witness this in progress, when more extensive and detailed performance figures will no doubt be available.

FRANCE'S "HENDON"

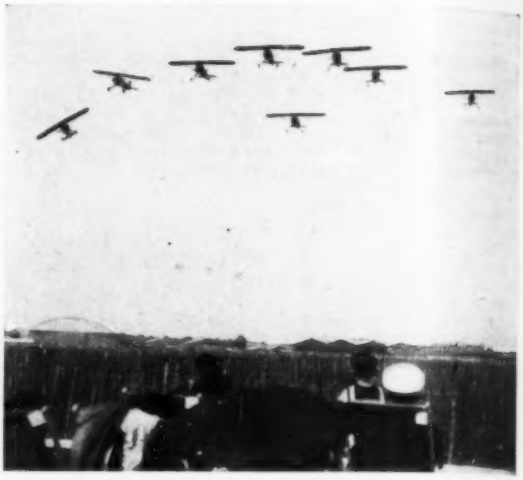
FRANCE'S parallel to our Hendon, the third annual National Air Display, was held recently at Villacoublay aerodrome. Several new items in the programme were strange to English spectators. In the first event a Zodiac "motor balloon"—actually a kite balloon turned blimp—manœuvred round the aerodrome at quite 32 m.p.h. with the help of a 60 h.p. Salmson engine attached to its long, narrow, quick-release, underslung fuselage. On landing this fuselage was rapidly exchanged for a basket, and observer, pilot and instruments were again borne aloft in a captive *saucisse*. At some 600 ft. the basket was cut adrift and dropped safely to the ground beneath a large parachute.

A clever display of individual and flight aerobatics by three Dewoitine fighters set things moving; then came a landing competition in which ten two-seater Mureaux took part, run on similar lines to this year's Hendon event.

The main display commenced at 2 p.m. when the President of the Republic and the Air Minister arrived with the Sultan of Morocco, and two companies of "aviation infantry" marched past. The Sultan's personal bodyguard marched into the enclosure to the *Marseillaise*, a hundred picked men, all over six feet, looking magnificent in their scarlet tunics, ebony faces shining beneath snowy white head-dresses.

An opening high spot was the aerial combat between a Marcel Bloch bomber and three Dewoitine 501 fighters. Aerobatics by Morane and Bleriots followed, in some cases flights being tied together. An exciting attack by a squadron of Dewoitine fighters was made on a mechanised company.

The fly-past of new types included two Morane 300 m.p.h. fighters, with 860 h.p. Hispano 12-Ycrs. engines, piloted by Michel Detroyat and Captain Rozanoff, a twin-engined Breguet 462 bomber, a Potez 63 three-seater, high speed, general purpose machine as seen at the last Paris show, and a Bloch 131 bomber. There was also a fly-past of large commercial types including the 40-passenger high-wing Farman 224 with four Gnome Rhone engines (entered for next month's Istres-Damascus Paris race) and the Bloch 300 and 220 with three and two Gnome Rhone engines respectively.



Something going to happen? Morane 225s at Villacoublay.

The penultimate event was the arrival of three twin-engined Potez troop carriers which dropped by parachute forty fully equipped aviation infantrymen with guns strapped to their legs.

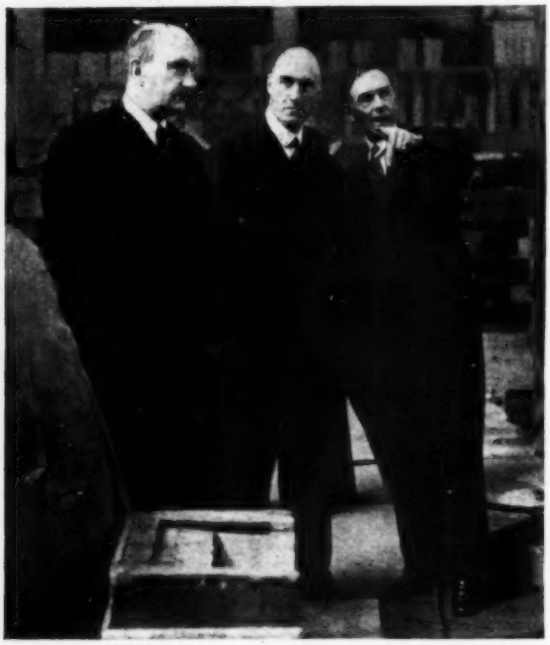
The display ended with a mass formation fly-past composed of over a hundred military machines. R. C. W.

Britain's Salon

THE new Earls Court provides a huge exhibition building which would be capable of housing a first-class aircraft show. Although it is not quite completed, several important events are already booked, including the International Motor Car Exhibition, the Cycle and Motor Cycle Show and the British Industries Fair.

The building, which cost £1,500,000, covers an area of twelve acres and is designed to seat 20,000 round a 200 × 350 ft. arena. The plain floor of this arena can be changed in a few minutes into the largest indoor swimming pool in the country or the whole may be divided into three conference or banqueting halls by means of quickly assembled partitions.

A garage has been erected to accommodate 2,000 cars on two floors, and within the main building service and lorry lifts are provided, besides five passenger lifts and six silent escalators.



SEEING HOW: Lord Swinton, Secretary of State for Air, recently visited the Handley Page works and saw the Harrow in quantity production. He is seen with (left) Mr. F. Handley Page (managing director) and (right) Mr. J. Hamilton (works manager). On the same day very different but no less interested visitors looked round the works—a party of schoolchildren on a visit from Columbia, B.C. (*Flight* photograph.)

R.-R. Reorganisation

AN important reorganisation scheme is taking place at the Rolls-Royce works at Derby, and the aero engine design, development and research departments have been entirely separated from the chassis division. Mr. Rowledge will act as general consultant and the aero engine division executives will be as follows: Chief engineer, Mr. A. G. Elliott; development and research engineer, J. E. Ellor; chief designer, T. B. Barrington.

Mr. L. E. Metcalfe

MR. L. E. METCALFE, whose resignation from the board of directors of Constant Speed Airscrews, Ltd., was announced recently in *Flight*, has asked us to convey to his friends in the aircraft industry his thanks for their enquiries during last week. Mr. Metcalfe hopes to deal with them in due course, and in the meantime requests that personal communications should be sent to him at 3, Emscote Road, Warwick.

S.B.A.C. Scholarships Awarded

FIVE scholarships in the aircraft industry have been awarded for 1937 under the scheme sponsored by the S.B.A.C. and administered by the R.Ae.C. The joint committee has interviewed eight youths selected from approximately 800 applicants, and has decided that the following five shall be the first holders of the S.B.A.C. scholarships: Frederick Barnes, son of an inspector in a motor car factory; John Dickenson, son of a mine foreman; B. P. Laight, son of a leading aircraftman in the R.A.F.; R. W. Miller, son of an employee at the Naval and Military Museum, Greenwich; and R. E. Stainton, son of an A.I.D. examiner at Cardington. Congratulations and a prosperous future!

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

No. 138. (Volume XV No. 1) 12th Year July 29, 1937.

TWO-SPEED BLOWERS

By D. L. PRIOR*

IN order to meet the requirements of modern fighting aeroplanes it is necessary to provide a power unit which combines the qualities of light weight and low drag with high power, both at altitude and on the ground. These requirements, however, must not be met at the expense of fuel economy.

With a blower of the centrifugal type, the power absorbed by the unit depends on the speed at which the blower is driven and the weight of air dealt with, while the temperature rise is governed by the pressure ratio of the blower, which in turn is a function of the rotor speed. Thus the power lost to the blower, and the temperature of the outgoing air, depend on the rotor speed and are not greatly affected by throttling at the intake for a given pressure ratio. To expand this point further, if a unit is designed to supercharge say to 1 lb. boost at 15,000 ft. at an engine speed of 2,600 r.p.m., then at ground level, if the engine is run at the same speed of 2,600 r.p.m. and the same boost, the supercharger will be delivering approximately the same weight of air and hence will be absorbing the same power. The weight of air is not *exactly* the same in the two conditions because of the difference in air temperature, but this does not cause a serious reduction in the power required to drive the supercharger at ground level.

Curves 1 and 2 show the relationship between rotor tip speed and power absorbed, and tip speed and temperature rise respectively, for an engine using 100 lb. of air per minute at 2,600 r.p.m. (roughly of 900 h.p.) at 1 lb. boost at 1,500 ft. Curve (3) is a typical rated altitude speed curve for a centrifugal blower and it can be seen from this that a rating of 1 lb. boost at 15,000 ft. would require a tip speed of 950 ft./sec. Thus the temperature rise of the air due to this would be 84° and the power absorbed 85 h.p. (curves (1) and (2)). Owing to the low atmospheric temperature at this great altitude, the temperature due to vaporisation of the petrol the final temperature of the mixture would only be 43° C.

At ground level, however, at the same speed the final mixture temperature would be 74° C., which would accentuate detonation trouble and reduce the available power considerably. In addition, the power absorbed by the blower would be approximately the same as at altitude, thus further impairing the take-off power of the engine.

Previous to the adoption of C.P. airscrews the propeller characteristics necessitated a much slower speed for take-off for a supercharged engine, due to the fact that the airscrew had to be designed for altitude conditions. This, coupled with the rather lower rated altitudes then in use, lessened the difficulties associated with the blower under ground level conditions very considerably. The high take-off speeds now possible with the C.P. airscrew, and the higher working altitudes now required, make it most desirable to improve the supercharger under take-off conditions.

The two-speed supercharger effects this improvement by combining in the one unit a supercharger designed to best advantage for take-off conditions in the low gear, together with a high gear giving the required altitude performance.

TABLE 1.

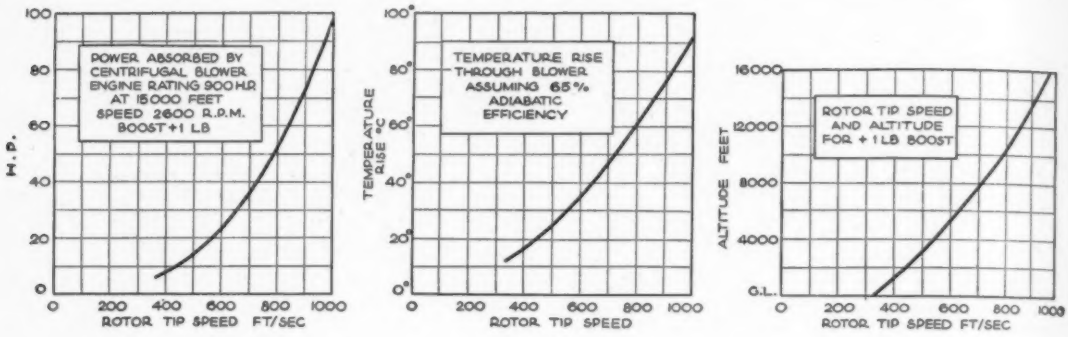
VARIATION IN AVAILABLE POWER FOR TAKE-OFF.

Engine Speed.	Condition.	Altitude, ft.	Boost lbs./sq. in.	Mixture Temp.	B.H.P. Gross.	Power for Blower.	Available Power, H.P.
2,600	Max. level at altitude	15,000	+1 lb.	+43° C.	985	85	900
2,000	Take-off Single-speed Blower. Fixed pitch prop	G.L.	+3 lbs.	+41° C.	985	39	946
2,450	C.P. Prop. Single-speed Blower ...	G.L.	+3 lbs.	+74° C.	1,085	72	1,013
	Two-speed Blower	G.L.	+3 lbs.	+19° C.	1,180	30	1,150

TABLE SHOWING IMPROVEMENT EFFECTED AT GROUND LEVEL BY TWO-SPEED BLOWER.

In Table 1, figures are given relating to a hypothetical engine delivering 900 h.p. at 15,000 ft. at 2,600 r.p.m. These figures illustrate the advantages to be obtained from a two-speed supercharger unit. The high gear of the two-speed blower is designed to give the same performance as the single-speed unit at altitude, while the low gear has been arranged to give a maximum take-off boost at full throttle.

* Mr. Prior is head of the experimental department of Armstrong Siddeley Motors, Ltd.


POWER ABSORBED BY CENTRIFUGAL BLOWER ENGINE RATING 900 H.P. AT 15000 FEET SPEED 2600 R.P.M. BOOST +1 LB
H.P.
ROTOR TIP SPEED FT/SEC
TEMPERATURE RISE THROUGH BLOWER ASSUMING 65% ADIABATIC EFFICIENCY
TEMPERATURE RISE °C
ROTOR TIP SPEED
ROTOR TIP SPEED AND ALTITUDE FOR +1 LB BOOST
ALTITUDE FEET
G.L.
ROTOR TIP SPEED FT/SEC

Curves 1-3, showing relationships between rotor tip speeds and power absorbed, temperature rise, and altitude respectively.

It can be seen that, with the two-speed supercharger in low gear at ground level, an additional 137 h.p. is available. This is due to the lower mixture temperature and reduction in power absorbed. In addition, the engine conditions will be generally improved by the lower mixture temperature.

As the power absorbed by the blower rises more rapidly than the increase in performance, and the effect of high intake temperatures becomes increasingly serious, it is evident that the advantages of a two-speed supercharger become still more apparent when the performance of engines of higher duty is considered.

Probably the most important advantage of the two-speed supercharger is the saving in fuel that can be effected by cruising at the working altitude of the engine. For its use when cruising, an engine is required to supply 2/3 of its maximum power, at about the same altitude as that given for maximum power. With a single-speed supercharger, this condition can only be met by throttling. With a fully supercharged engine, with a single-speed blower rated at say 15,000 ft., the power absorbed by the blower is still large under cruising conditions and the mixture temperature high. The effect of these two factors is to raise the specific fuel consumption, and in practice it is not found possible to reduce this much below about .54 pt./b.h.p./hr.

Low Consumption

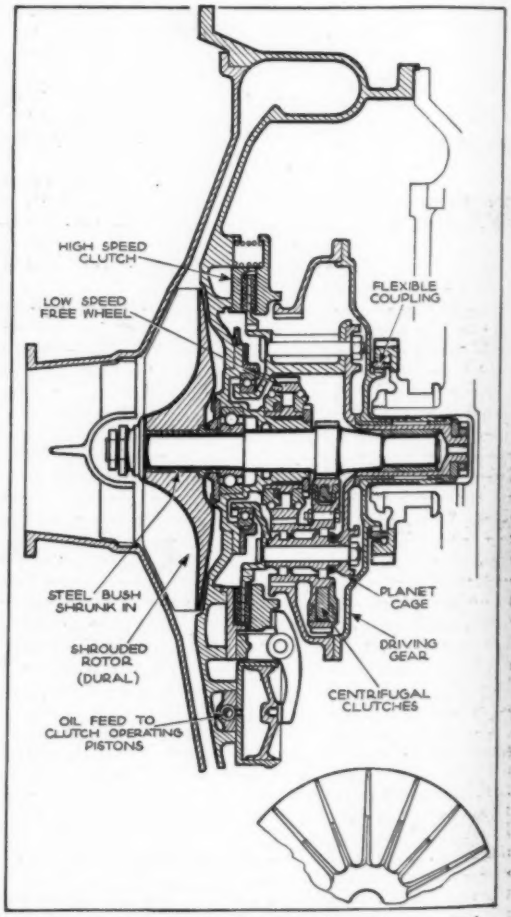
With a two-speed blower, however, instead of throttling back to get cruising power at altitude, this condition can be achieved at or near full throttle by changing into low gear. The condition is then equivalent to running a moderately supercharged engine with a rating of about 5,000 ft. at 15,000 ft., with the important difference that maximum power is instantly available, if and when required, by changing into high gear. Under these conditions the supercharger is just doing the work required to give cruising power and no more; the power absorbed by the blower is small and the mixture temperature is low and it is thus possible to reduce the specific fuel consumption to about .49 pt./b.h.p./hr. This represents a saving of 10 per cent. on the fuel consumption under cruising conditions, directly due to the provision of a two-speed supercharger, with a consequent valuable increase in cruising range for the aircraft.

Provision of a two-speed drive to the supercharger can be made in various ways. One form consists of two independent sets of gearing, one or the other being used as required by suitable clutch mechanism.

In the Armstrong Siddeley units high gear is obtained by a simple train or back gearing, which for low gear is allowed to function as an epicyclic system. This compact design has proved to be light in weight, and mechanically sound, while reducing to a minimum the necessary control mechanism.

The first two-speed supercharger unit designed and made by Armstrong Siddeley was completed in 1930. Fitted to the Panther engine it successfully passed its tests on the bench and in flight. An illustration of this early unit is given below.

Two trains of gears were provided, which in any case would be normally required for a single-ratio blower. The high-gear drive consisted of three radially disposed sets of back gears, driven through a spring drive mechanism from the rear of the crankshaft. The three layshafts with their planet wheels were mounted in a cage which could be allowed to rotate around the axis of the unit.



Sectional view of the first experimental two-speed supercharger.

In the high gear the planet cage was held stationary by means of a hydraulically operated clutch. For the low gear, the cage was released, the drive reaction being taken by a centre gear co-axial with the rotor shaft, this gear being adapted to run freely when high gear was in engagement.

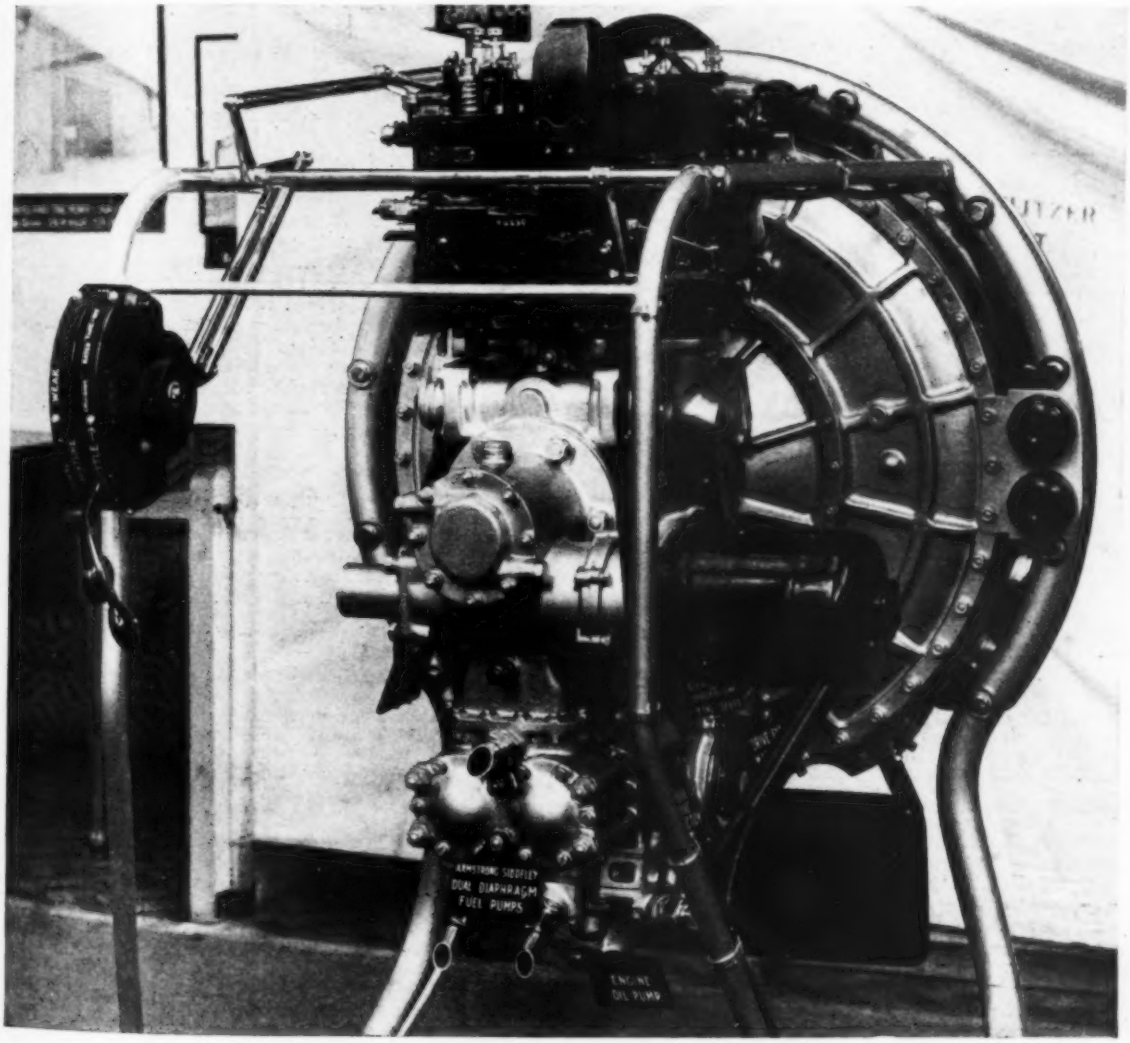
Mechanically this unit was very successful but the gearing arrangement, although having the advantage of simplicity, limited the range of variation between high and low gears. Actually the low gear ratio proved to be too low in practice and the next design, although incorporating the same principle, introduced a third set of gearing which allowed greater latitude in the selection of ratios. In this design great attention was given to saving weight, and the unit with its necessary additional control gear was produced at the same weight as the single-speed blowers then in use. This unit also proved successful.

Owing to the absence at the time of a suitable C.P. airscrew, the full advantage to be gained by the use of a two-speed supercharger could not be realised, and as a result further development was delayed.

The unit now in use on the Armstrong Siddeley Tiger VIII engine has successfully passed its type test and is now in production. It embodies the same principle of a triple gear train having a simple back gear drive for high speed, and epicyclic gear for the low gear.

It has been completely redesigned to incorporate the benefit of the experience recently gained as the result of prolonged experiments on the supercharger research bench. Mechanically the chief point of difference from the previous unit is the elimination of the free wheel and the substitution of a simplified hydraulic control to both the high and the low gear while the experimental work referred to has enabled the design of the rotor and diffuser to be much improved.

A feature of all the Armstrong Siddeley two-speed supercharger units is the ease of control of the change-speed mechanism. The operating clutch is engaged by oil pressure from the main engine supply, control being effected by a simple "push-pull" type of plunger valve which directs the oil as required. This control is light in operation and has proved satisfactory, automatically providing sufficient delay action to prevent a too sudden change in gear ratio.



Back cover and accessories, including two-stage blower, of the Siddeley Tiger VIII engine, which is the standard power plant of the Armstrong-Whitworth-Whitley heavy bomber.

TAXYING-BUMPS

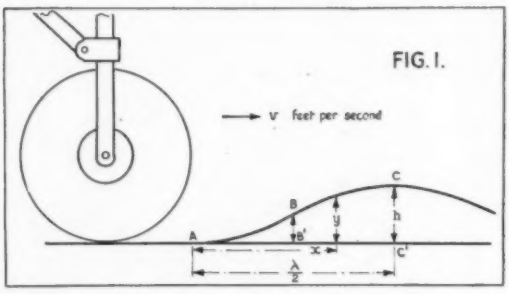
An Estimate of the Loads on the Undercarriage of an Aircraft When Taxying

By A. E. PARKER, B.Sc.

Of the simplifying assumptions used in dealing with the loads on the undercarriage of an aircraft when taxying, A.P. 970 states "This has been done in order to avoid complicated dynamical calculations of a complexity unwarranted by the arbitrary nature of the basic assumptions." In the following article Mr. Parker examines the problem and arrives at some interesting results.

WHEN an aircraft is taxying over an uneven aerodrome extra loads are thrown on to the undercarriage of the aircraft due to the upward acceleration caused by bumps. It is proposed in this article to investigate the effect of these bumps.

Fig. 1 shows one wheel of an aircraft which is moving towards the bump shown with a velocity of v feet per second. As the wheels of the aircraft move from A to B there will be an upward acceleration, but from B to C the acceleration will be downwards, *i.e.*, the aircraft will have a tendency to leave the ground.



It is assumed here that both wheels travel over the same bump which has the same shape and size at both wheels. Now when the wheel has moved from A to B the Centre of Gravity of the aircraft must be raised through a vertical distance BB', *i.e.*, $\frac{h}{2}$ provided that there is no tyre or undercarriage deflection. Now the aircraft will travel the distance AB' or $\frac{\lambda}{4}$ in $\frac{\lambda}{4v}$ secs. and during this time the aircraft has been raised a vertical distance $\frac{h}{2}$ ft. and therefore the mean acceleration must have been : $\frac{16v^2h}{\lambda^2}$.

As a numerical example take $\lambda = 60'$ and $h = 1'$ and we see that the upward acceleration necessary is $\frac{16 \times 88^2 \times 1}{60^2}$, *i.e.*, 1.07 g. ft./sec./sec. and this would necessitate an upward force of 1.07 W, where W is the weight of the aircraft, supplied by the undercarriage of the aircraft. This load would be extra to the load already taken by the undercarriage due to the aircraft's weight. In the above example the aircraft was, of course, assumed to be travelling at 60 m.p.h.

It is interesting to note that if we halve h and also halve λ the necessary acceleration is doubled because in the above formula for the average acceleration h occurs in the numerator only to the first power, but λ occurs in the denominator to the second power. It follows therefore that if h is 3 in. and λ is 15 ft., the average upward acceleration of the aircraft must be about 4.28 g. and the undercarriage would have to supply an upward force of 4.28 W which would be an extra load to that already on the undercarriage. If we take an extreme case of a very small bump where h is 1 in. and λ is, say, 6 in. then the average acceleration necessary would be: $\frac{16 \times 88^2}{(\frac{1}{2})^2} \times \frac{1}{12} = 1282$ g.

This acceleration would necessitate a tremendous load on the undercarriage of the aircraft and on the aircraft itself, but in all the above examples it has been assumed that the undercarriage and tyres do not deflect. In practice, however, the undercarriage and tyres do deflect so that the centre of gravity of the aircraft is not raised very much when the aircraft passes over a bump and hence the large loads previously found do not occur. In fact, considering the last example where the bump had a height of only 1 in. the tyre deflection alone would easily absorb the shock of this bump.

In the first example considered, where h was 1 ft. and λ was 60 ft., in order that the C.G. of the machine did not rise at all it would be necessary for the total undercarriage deflection (*i.e.*, oleo and tyre) to be 1 ft. This is rather a large deflection and would mean a large load acting on the undercarriage. Of course, in practice, the C.G. of the machine is raised and the undercarriage deflects when passing over a bump, these two variables adjusting themselves so that the load on the undercarriage of the aircraft is a minimum. The load induced in the undercarriage clearly depends on the rate at which the oleo strut will contract when under load and it is obvious that no generalisations can be made concerning shock absorbing struts, this being a matter for individual investigation.

It appears from the foregoing that the taxying loads on ordinary aircraft are not unduly severe, but when an aircraft is forced to land in a field where the ground is possibly far from level there is a danger of a damaged undercarriage. It is interesting to note here that many long-distance record breaking pilots (*i.e.*, pilots flying to the Cape, India or Australia) have damaged their undercarriages when making landings on unprepared ground. Of course this may or may not be due to the effects investigated in this article, but the fact is significant.

The Long-range Case

The taxying loads in the case of long-distance record breaking planes are, however, somewhat severe. Let us assume that a long-range machine is loaded so that its take-off speed is 90 m.p.h. and it passes over a bump where h is 6 in. and λ is 30 ft. then the acceleration required, assuming as before that there is no undercarriage deflection, is about 4.8 g. and this would necessitate an upward load of 4.8 W, where W is the loaded weight of the plane, which would, of course, be extra to the load already on the undercarriage. Again, W here is the loaded weight of the aircraft and this would be much more than the normal loaded weight of the plane. Even allowing for undercarriage deflection here the load on the undercarriage would be very severe and failure likely unless of course the aircraft had been provided with a special undercarriage having a long travel of the oleo strut.

When an aircraft is taxying over wet and soft ground and it comes suddenly to a patch of hard ground this would have the same effect as a bump, but this case cannot be very easily investigated and it is probable that the undercarriage could take care of the acceleration produced.

If it is thought necessary to investigate the strength of an undercarriage more fully than by the method previously given this can be done by assuming that the shape of the bump is a sine curve, its equation being :

$$y = \frac{h}{2}\left\{1 + \sin\frac{2\pi}{\lambda}\left(x - \frac{\lambda}{4}\right)\right\}$$

where x and y are measured as is shown in Fig. 1. Put x equal to vt where t is the time in secs. and we get :

$$y = \frac{h}{2}\left\{1 + \sin\frac{2\pi}{\lambda}\left(vt - \frac{\lambda}{4}\right)\right\}$$

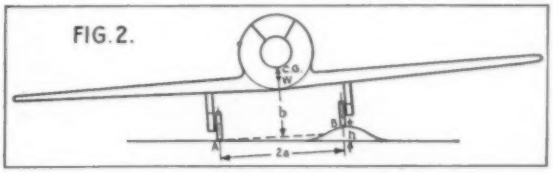
The acceleration is given by $\frac{d^2y}{dt^2}$ *i.e.*,

$\frac{dy^2}{dt^2} = -\frac{h}{2}\frac{4\pi^2}{\lambda^2}v^2 \sin\frac{2\pi}{\lambda}\left(vt - \frac{\lambda}{4}\right)$ and this is a maximum at A where t is supposed zero.

$\therefore$ Max. $\frac{d^2y}{dt^2} = \frac{2h\pi^2}{\lambda^2}v^2$ or $\frac{19.74\,v^2h}{\lambda^2}$ which compares with the average acceleration $\frac{16v^2h}{\lambda^2}$ previously found.

The strength of the undercarriage could now be investigated by a step by step method taking into account the deflection of the tyres and oleo struts. The method would be somewhat laborious, but well worth while in the case of a world's long-range record attempt. By previously measuring the undulations on the aerodrome where the attempt is to be made an estimate of the strength of the undercarriage of the aircraft could be made and this extra bit of trouble might save the lives of two very good pilots. Of course the best plan is to choose an aerodrome where there are no undulations.

Case 2 One Wheel Only goes over a Bump.—When one wheel only goes over a bump the effect produced is that



the centre of gravity of the aircraft is raised and that the aircraft rotates about the point of tyre contact of the wheel which did not go over the bump. This case, however, is not likely to produce serious loads, because if the bump is a small one then only one wheel will go over it and the deflection of the oleo strut will be able to absorb the shock. Fig. 2 shows an aircraft taxying over a bump with one wheel. The C.G. of the aircraft has been raised and the aircraft rotated about the point of tyre contact A. However, the loads produced when one wheel passes over a bump are probably less severe than when an aircraft lands on one wheel and a large side load is produced. This has been dealt with in *The Aircraft Engineer*, by B. B. Walker, B.Sc. (See *Flight*, February 28, 1935.)

TECHNICAL LITERATURE

SUMMARIES OF A.R.C. REPORTS

REPORTS published by His Majesty's Stationery Office London, which may be purchased directly from H.M Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester, 1; St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through booksellers.

THE COWLING OF COOLING SYSTEMS. By R. S. Capon, O.B.E., B.A., F.R.Ae.S. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1702. (23 pages and 3 diagrams.) March, 1936. Price 3s. 6d. net.

It is well known that the drag of a radiator or air-cooled engine may be diminished by expanding the flow in a cowl so as to reduce the speed of flow over the cooling surfaces. A limit to the improvement obtainable in this way is set, in a radiator system, by the bulk and weight of the radiator required to provide adequate cooling at the reduced speed of flow; in the air-cooled engine a limit is reached when any further reduction of the speed of flow over the cylinders would cause the maximum allowable cylinder temperature to be exceeded.

A fixed cowl and radiator cannot give optimum conditions over a range of flight speeds: control of the flow of cooling air is required so as to provide just adequate cooling under all conditions of flight. If full advantage is to be obtained, clearly the flow must be regulated so that the required range is covered without unnecessary dissipation of the energy of the stream by the controlling system, for a loss of energy will involve additional drag.

The cowled radiator is considered, with special reference to the type in which the flow of cooling air is controlled by altering the cowl rear exit area. In a preliminary examination the variation of air density is neglected: the modifications required when variation of density is included are then discussed.

In an appendix the performances of a cowled radiator are compared when the flow of cooling air is controlled: (*a*) at the rear exit, (*b*) by shutters at the entrance, (*c*) by retracting the radiator and (*d*) when it is not controlled. In another appendix a method of analysing the results of wind tunnel experiments on cowled radiators is suggested. The report deals primarily with radiators for liquid coolants, but a reference is made to the cowled air-cooled engine.

Of the four methods of control, variation of cowl exit area is the most efficient: in principle this method of control is ideal, since no dissipation of energy of the flow is necessarily involved, and the proportion of engine power required to overcome the cooling drag becomes less as the flight speed is increased. Control by retraction of the radiator gives an increase of proportionate power as the square of the flight speed. If there is no control, the increase is as the cube. Shutters at the entrance give the least efficient type of control, the power absorbed in cooling increasing with speed rather more rapidly than when there is no control.

FULL SCALE EXPERIMENTS AT HIGH INCIDENCES WITH A IIIF SEAPLANE. By A. E. Woodward Nutt, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1703. (22 pages and 21 diagrams.) February 8, 1934. Price 3s. 6d. net.

No measurements of lift, drag and elevator angles required to trim have hitherto been made for full scale seaplanes at angles of incidence much above the stall, and even for landplanes the data on the subject are scanty. Wind tunnel experiments made at the N.P.L. with a 1/15th scale model of a IIIF seaplane (with no wing tip auto-slots), in connection with the research on the spinning of seaplanes, showed that a trimming incidence of 49° was reached with the elevators fully up, as compared with a value of 23° for the same model without floats. As spinning tests on the full scale IIIF seaplane were contemplated, it was decided, as a preliminary experiment, to measure the lift, drag and elevator angles on an aircraft of this type during glides at as high angles of incidence as possible, in order to ascertain whether incidences of the order indicated by the model tests were actually attainable on the full scale aircraft, and also in order to extend the full scale lift and drag curves to incidences greater than those previously reached.

The exceptionally high trimming incidences indicated by the model tests can be reached on the full scale IIIF seaplane. A number of glides have been completed at incidences over 37° and two at incidences of about 50°. As far as is known the highest incidence previously reached in glides with any type of aircraft was 33°.

In glides at these high incidences, the control column of the IIIF is pressed firmly back, and the aircraft is so unstable both laterally and longitudinally as to be barely controllable.

The maximum lift coefficient, C_L, for the IIIF seaplane is 1.248 at an incidence of about 22°. The lift curve is fairly flat topped, the lift coefficient at 50° incidence being 0.908. The lift and drag curves are in close agreement with the previous full scale measurements, and are in quite good agreement with the model results.

The special wings of R.A.E. design slightly improved the lateral stability of the aircraft, but did not enable glides at still higher incidences to be made. The trimming curve for the aircraft with the R.A.E. wings was steeper than that for the standard aircraft, so that the maximum incidence reached was only 40° at the same maximum elevator angle (—22°) as before. The maximum lift coefficient of the aircraft was unchanged by the modifications, but the lift and drag of the modified aircraft were both rather higher than those of the standard aircraft at incidences greater than about 25°.

The upward elevator angles required to trim the full scale aircraft are in general smaller than those measured on the model, and the model trimming curves show a curious kink at high incidences which was not reproduced in the full scale tests.

TRAILING EDGE FLAPS IN RELATION TO TAKE-OFF AND LANDING OF LANDPLANES. By S. B. Gates, M.A. Communicated by the Director of Scientific Research, Air Ministry. R & M. No. 1707. (31 pages and 24 diagrams.) August 23, 1935. Price 4s 6d. net.

A survey of the potentialities of trailing edge flaps as aids to take-off and landing with high loads is given in these notes. The model evidence on the lift and drag characteristics of trailing edge flaps of several types—plain, split, slotted and Fowler—is analysed and set out in a form convenient for quick application in aeroplane design. It is used in an attempt to decide which types of flap, and in what circumstances, can be used to assist take-off. Diagrams are constructed from which rough estimates can be made of the size and type of flap necessary to land an aircraft of given loading and unflapped characteristics in a specified distance in given ground conditions. The problem of the very highly loaded aircraft has been considered, loadings up to 30 lb./sq. ft. being included in the calculation.

There is an important distinction between the split and the slotted flap. These give lift increases of the same order, but the increased drag which is necessary to produce the increased lift is much less with the slotted than with the split flap. The first requirement for improvement of take-off is increased lift with a minimum of

increased drag, while in landing increased drag is, within limits, as useful as increased lift. Hence the slotted flap and its extension—the Fowler—should be of particular use for take-off.

The utility of flaps for take-off depends essentially on the thrust/weight ratio from rest to the take-off speed. If this lies between 0.2 and 0.3 only a slotted flap can be used with advantage, if it is greater than 0.3 almost any form of flap is likely to effect some saving.

The increased load which can be taken off in a given distance by the use of flaps depends very greatly on the available thrust.

The problem of landing a load of 20 lb./sq. ft. and upward in a given distance admits, broadly speaking, of two solutions. If a split flap of large size is fitted, giving high drag and comparatively small lift, the glide will be steep and fast and the landing speed high. If, on the other hand, a large size Fowler is used, giving comparatively small drag and high lift, the glide will be flatter and slower, and the landing speed will be lower.

The Fowler flap is only slightly superior to a slotted flap as a saver of distance either in take off or in landing. But it extends the range of maximum lift coefficient well beyond that obtainable with other forms of flap, and the consequent reduction of maximum speed on the ground and of rate of descent are practical advantages which may make its use essential for getting loads of over 20 lb./sq. ft. off and on to the ground.

TESTS ON TWO STREAMLINE BODIES IN THE COMPRESSED AIR TUNNEL. By R. Jones, D.Sc., D. H. Williams, B.Sc., and A. F. Brown, B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1710. (6 pages and 2 diagrams.) April 29, 1936. Price 1s. net.

Models of two airship forms have been tested in the compressed air tunnel up to a Reynolds number of 49×10^6, the standard length being the length of the model. The forms were the original hull of R.101 and R.102, a shape having the same fineness ratio as R.101 but with a 10 per cent. greater block coefficient. The results are given on a surface area basis. There is a wide transition band from laminar to turbulent flow, but the curves are well defined above $R = 10^7$, where they lie above the turbulent skin friction curve.

It is proposed to undertake drag tests on other models of different fineness ratios, and also to investigate the effect of surface roughness.

FULL SCALE AND MODEL PORPOISING TESTS OF THE SINGAPORE IIc. By W. G. A. Perring, R.N.C., and J. L. Hutchinson, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1712. (26 pages and 11 diagrams.) November 23, 1935. Price 3s. 6d. net.

The technique of testing dynamic models in a tank was developed at the Royal Aircraft Establishment about three years ago, and during the time that has elapsed since then a large number of dynamic models have been tested. Although it was believed that the model results corresponded closely with the full scale, no opportunity of a direct comparison between the model and full scale results occurred. Accordingly, model and full scale tests have been carried out on a typical seaplane. Tests in the R.A.E. tank were made on a 1/12 scale dynamic model and the full scale tests were undertaken at Felixstowe; an account of both the model and full scale tests is contained in the present report.

The tests have demonstrated the usefulness of the model method of investigating the behaviour of seaplanes on the water in the planing condition. Tests on the dynamic Singapore IIc model, showed that with the centre of gravity in the normal position, the model was extremely stable, and the angular range of stability should enable the full scale seaplane to take-off and land without experiencing any porpoising tendencies. The model tests showed that porpoising should only be possible full scale at small angles of incidence when the centre of gravity is moved forward of the normal position, and at large angles when the centre of gravity is moved aft. The vertical movement of the centre of gravity, overload conditions and increased pitching moment of inertia, were all found to have a negligible effect on the stability limits.

The full scale tests agreed with the model in showing the great stability of the Singapore IIc under all normal operating conditions. Full scale instability occurred at extreme attitudes and loadings, at small angles with centre of gravity forward and large angles with centre of gravity back, in close agreement with the model results.

A comparison of the model and full scale results showed that the porpoising periods, model and full scale, were in very good agreement.

A NEW FORM OF BIPLANE. By H. B. Irving, B.Sc., and A. S. Batson, B.Sc. APPENDIX I. WHIRLING ARM EXPERIMENTS. By A. S. Halliday, B.Sc., Ph.D., D.I.C. APPENDIX II. FREE SPINNING TUNNEL EXPERIMENTS. By R. H. Francis, M.Sc. APPENDIX III. THEORY OF A SPINNING MODEL TEST. R. & M. No. 1715. (44 pages and 30 diagrams.) Price 7s. net.

The report deals with experiments on a new form of biplane whose special property is stability in roll up to angles of incidence of over 40° without any appreciable loss in performance in normal flight or extra weight entailed by additional mechanism or parts. Maximum lift is slightly increased and there are minor advantages as regards gliding angle for coming in to land, aileron control and possibly spinning.

In this biplane the wings converge towards the tips owing to the lower wing being given an unusually large dihedral angle (12½°). The lower wing is also swept forward 10° and is of constant chord, while the upper wing is highly tapered.

Half-wing experiments which gave promising results were followed by experiments on a biplane cellule. The half-wing experiments included measurements of aileron and wing tip control.

All the earlier experiments were made with R.A.F.15 section, but check experiments were made later with R.A.F.38 section, first with a half-wing model, then on the rolling properties of a biplane cellule. Free spinning tunnel experiments were made at the R.A.E. with a complete model having wings of R.A.F.34 section.

The most important result is that stability in roll on the model scale to over 40° incidence has been obtained without any appreciable loss in performance in normal flight or when climbing. Maximum lift is slightly increased and the stall is a gradual process, beginning with a premature stalling of the upper (tapered) wing tips, which spreads inwards as the incidence increases. After the upper wing is completely stalled the lower wing begins to stall at the centre, but the stalling of the lower wing does not reach the tips until about 40° incidence.

The early stalling of the upper tips leads to an early and more gradual retrograde movement of the centre of pressure than is usual, as well as a steeper gliding angle near the stall.

Aileron control is normal at ordinary flying angles, but falls off less than is usual at angles near the usual stall; adverse yawing moment in this region is also less than usual.

The whirling arm results show unusually large values of rolling moment due to a rate of yaw at high angles of incidence.

The biplane will behave similarly in a prolonged spin to an equivalent orthodox biplane of high stagger, but no conclusion can be drawn as to liability to accidental spins.

FULL SCALE TESTS OF SLOTS AND FLAPS ON A HEINKEL He.64 WITH SPECIAL REFERENCE TO LANDING. By J. E. Serby, B.A., and H. B. Squire, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1713. (15 pages and 10 diagrams.) November 5, 1935. Price 2s. 6d. net.

The Heinkel He.64 is a low wing monoplane equipped with lift slots, tip slots and plain flaps, which together give it a high speed range and enable it to do freak landings and take-offs. It was originally intended to use it to examine the technique of the "crash" landing but in spite of a special long-travel undercarriage it proved unsuitable for this, and the experiments were limited to measuring the ordinary aerodynamic characteristics and some landings. For the latter a photographic method was developed.

Handling trials were done at low speeds. Lift and drag, trimming curves and landings were measured with the aircraft in two conditions, (*a*) lift slots shut and flaps neutral, (*b*) lift slots locked open and flaps locked down. The tip slots were free in all the tests.

The slots and flaps raise $C_{L max.}$ from 1.44 (at $\alpha = 20$ deg.) to 2.2 (at $\alpha = 30$ deg.), and increase the profile drag of the wings by about 0.032, the minimum gliding angles in conditions (*a*) and (*b*) being 5¾ deg. and 7 deg.

As a landing device they are poor, since, due to the slots, the max. C_L in condition (*b*) is reached at too high an incidence for a normal landing, and consequently much of the reduction in stalling speed has to be sacrificed, a $C_{L max.}$ of 1.66 being the highest usable. The increase in gliding angle is small. By comparison a 0.15*c* split flap covering the same span would raise $C_{L max.}$ from 1.40 to 1.90 and increase γ to 8½ deg. or 9½ deg. for flap angles of 60 deg. or 90 deg.

The aircraft cannot easily be stalled in condition (*b*) as a very aft C.G. is required to do this. When stalled, however, it is very unstable laterally. Stalled in condition (*a*) the tip slots make it nearly stable. The rudder control is worse at the lower stalling speed condition (*b*) but no effect of the flaps on the elevator was noticed.

The landing distance from 50 ft. to rest is decreased from 1,700 ft. to 1,300 ft.—a saving of 24 per cent. (no wheel brakes being used).

TESTS OF AEROFOILS R.A.F. 69 and R.A.F. 89, WITH AND WITHOUT SPLIT FLAPS, IN THE COMPRESSED AIR TUNNEL. By D. H. Williams, B.Sc., A. F. Brown, B.Sc., and E. Smyth, B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1717. (24 pages and 6 diagrams.) May 25, 1936. Price 3s. 6d. net.

The use of thick sections for wing profiles has become common with the development of internally braced cantilever monoplanes, and with the use of tapered wings. The thickest sections hitherto tested in the Compressed Air Tunnel have been of the order of 15 per cent., and little information is available regarding the behaviour of thick sections at high Reynolds numbers. The minimum drag of such sections is found to increase rapidly with thickness whereas the maximum lift decreases as the thickness is increased except at low values of Reynolds number. The addition of flaps, however, increases the maximum lift to the same value as that for a thin section with flaps.

Two sections R.A.F. 69 and R.A.F. 89, of thickness 20.7 per cent. and 25 per cent. respectively, were tested up to a Reynolds number of 6×10^6 at positive and negative incidences, with 15 per cent. split flaps placed 15 per cent. forward of the trailing edge.

PRELIMINARY CALIBRATION OF THE 24-FOOT WIND TUNNEL, R.A.E., WITH A SHORT DESCRIPTION OF THE TUNNEL. By W. G. Jennings, B.Sc., A. Terry, B.Eng., and P. J. Pearsall. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1720. (8 pages and 11 diagrams.) July, 1935. Price 2s. 6d. net.

A preliminary exploration of the airflow in the R.A.E. 24-ft. tunnel, including a calibration of the air speed at certain sections of the working jet, has been made. These measurements were not intended to cover a complete investigation of the conditions of flow in the tunnel, but to provide sufficient data for the tunnel to be used for the first series of full-scale tests on the tunnel programme. A short description of the main features of the tunnel is included in an appendix to the report.

The working of the tunnel in its present form is satisfactory; within the centre 20 ft. of the jet the distribution of the velocity at any one section was within 1½ per cent. of the mean.

As originally designed severe pulsations occurred in the airflow at high speeds; by introducing fifteen tabs 6 in. square into the jet at the nozzle the periodic fluctuations of the airstream were eliminated; the addition of these tabs did not affect the energy ratio of the tunnel appreciably, but the static pressure gradient down the axis of the jet was adversely affected.

THE INFLUENCE OF DIFFERENTIAL AILERON CONTROL ON WING FLUTTER. By R. A. Frazer, B.A., B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1723. (20 pages and 7 diagrams.) September 10, 1934. Price 3s. net.

The influence of differential aileron control on wing flutter recently came under consideration in connection with an investigation of the flutter characteristics of a model Puss Moth wing. The present report gives an account of the underlying theory.

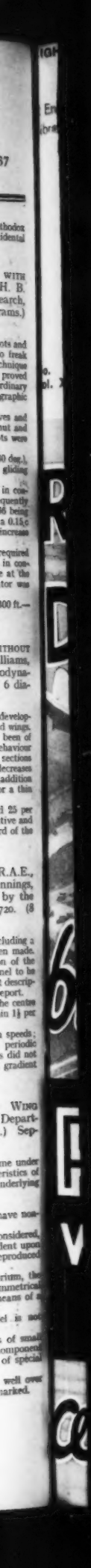
The principal conclusions are as follows:—

(1) The basic dynamical equations involve 7 degrees of freedom and have non-linear characteristics.

(2) If only small motions about a general equilibrium position are considered, the effective aileron stiffnesses and moments of inertia are acutely dependent upon the lateral control setting and the airspeed. The motion can only be reproduced in the wind tunnel by means of a complete model.

(3) In the special case where the control column is central in equilibrium, the motion is resoluble into a symmetrical ternary constituent and an anti-symmetrical quaternary constituent. Both of these motions can be reproduced by means of a half-model of the aeroplane.

(4) The lowest critical speed obtainable by means of a half-model is not necessarily the lowest possible for the actual aeroplane.

(5) In the ideal case where the cables are inextensible the equations of small motions about a general equilibrium position are resoluble into a binary component (pure flexure-torsion of the wings) and an "anti-symmetrical" motion of special type.

(6) Rough calculations indicate that when the control column is set well over the reductions of the upward aileron angles at high airspeeds are very marked.